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BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

The BDM Corporation
7915 Jones Branch Drive
McLean, Virginia 22101

26 May 1978

Interim Report for Period 16 November 1977–26 May 1978

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A major assumption underlying the calculation of casualties from a nuclear exchange concerns the time civilian populations can be expected to stay in fallout shelters. Presently, two general guidelines are used: 1) one week of shelter stay followed by two weeks of partial shelter occupancy and, 2) a two day shelter stay followed by three days of partial shelter occupancy.			

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20. ABSTRACT (Continued)

The objective of this program is to explore the nature of these assumptions using behavioral sciences data.

Systematic quantitative estimates of shelter stay times can be obtained from an empirical data base. Length of shelter stay is dependent on a variety of variables the most important being degree of preparedness. Generally, post attack behavior will be the range considered normal. The use of quantitative estimates of fallout shelter stay time reduces the variability associated with predicting the human factor in strategic simulations.

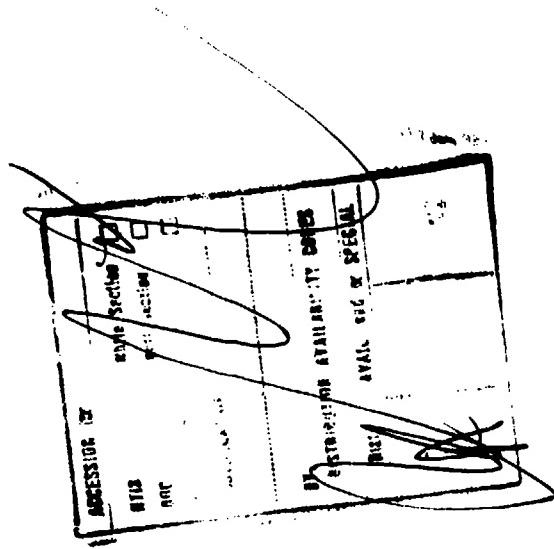
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BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY



Behavioral Aspects of Fallout Shelter Stay

Summary

Objective

A major assumption underlying the calculation of casualties from a nuclear exchange concerns the time civilian populations can be expected to stay in fallout shelters. Presently, two general guidelines are used: 1) one week of shelter stay followed by two weeks of partial shelter occupancy and, 2) a two day shelter stay followed by three days of partial shelter occupancy.

The objective of this program is to explore the nature of these assumptions using behavioral sciences data.

Approach and Method

Behavioral studies of fallout shelter occupancy, human response to disasters and isolation/confinement studies were systematically surveyed for quantitative estimates of time spent in shelters and qualitative data bearing on the behavioral profile of shelterees. Three thousand estimates were derived from approximately seven hundred studies. Eight general categories of data were identified: 1) physiological, 2) shelter space, 3) shelter type, 4) warning, 5) training, 6) shelter management, 7) evacuation posture and 8) communication. For each of these categories, estimates of propensity for attrition (a quantitative measure of expected shelter stay time) were derived as a function of time since sheltering. Results were refined by eliminating data from incidents not analogous to a post attack environment. Qualitative behavior profiles derived from questionnaires, interviews and observations were developed and used to interpret the quantitative data.

Major Findings

Systematic quantitative estimates of shelter stay times can be obtained from an empirical database. Length of shelter stay is dependent on a variety of variables the most important being degree of preparedness. Generally, post attack behavior will be in the range considered normal. The use of quantitative estimates of fallout shelter stay time reduces the variability associated with predicting the human factor in strategic simulations.

Application to Post Attack Environments (PAE) and Soviet Populations

The results of this study are based on data collected in an American environment under conditions similar to a PAE, but by no means fully capture, what such an environment might be like. However, there is a good reason to believe that the human response to disaster is applicable to the post attack environment. The elements of the process of coping with disaster are so similar across time and culture, that it would not be parsimonious to believe that the post attack environment would spawn a completely different type of behavior.

The application of program data to Soviet populations is a major study limitation. One way of contrasting Soviet preparation with that of the United States is to compare best and worst cases for the study variables.

The current controversy over the degree of Soviet preparedness has not been resolved to the point where a single position can be used to interpret stay time estimates. We can say however, that if the Soviets are better prepared than we, than their expected stay times might be similar to the times of the prepared groups represented by the database presented here.

*BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY*

BRIEFING OUTLINE

1. OBJECTIVES
2. APPROACH
3. SCENARIO
4. DEFINITIONS
5. DATA SUMMARY
6. MAJOR FINDINGS
7. USAGE
8. VARIABLES
9. CRITERIA
10. SOURCES
11. SHELTER STAY TIME CURVES

**BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY**

OBJECTIVES

- 1. TO EXPLORE THE ASSUMPTIONS UNDERLYING
ESTIMATES OF FALLOUT SHELTER STAY TIMES**

- 2. TO EXPLORE THE POTENTIAL EFFECTS OF
BEHAVIORAL SCIENCE DATA ON THESE
ESTIMATES**

*BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY*

APPROACH

1. IDENTIFICATION OF PERTINENT DATA
2. CLUSTER ANALYSIS FOR IDENTIFICATION OF QUANTIZED CRITICAL VARIABLES
3. COMPILATION OF PILOT DATA
4. REANALYSIS OF DATA
5. APPLICATION OF CRITERIA
6. REANALYSIS OF DATA
7. DATA REDUCTION AND CURVE FITTING

*BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY*

SCENARIO

- ONE MONTH OF INCREASING INTERNATIONAL TENSION
- TWO-THREE DAYS OF CRITICAL INCIDENTS
- MIXED COUNTERFORCE/COUNTERVALUE STRATEGY
- EXCHANGE COMPLETED WITHIN 24 HOURS.

BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

DEFINITIONS

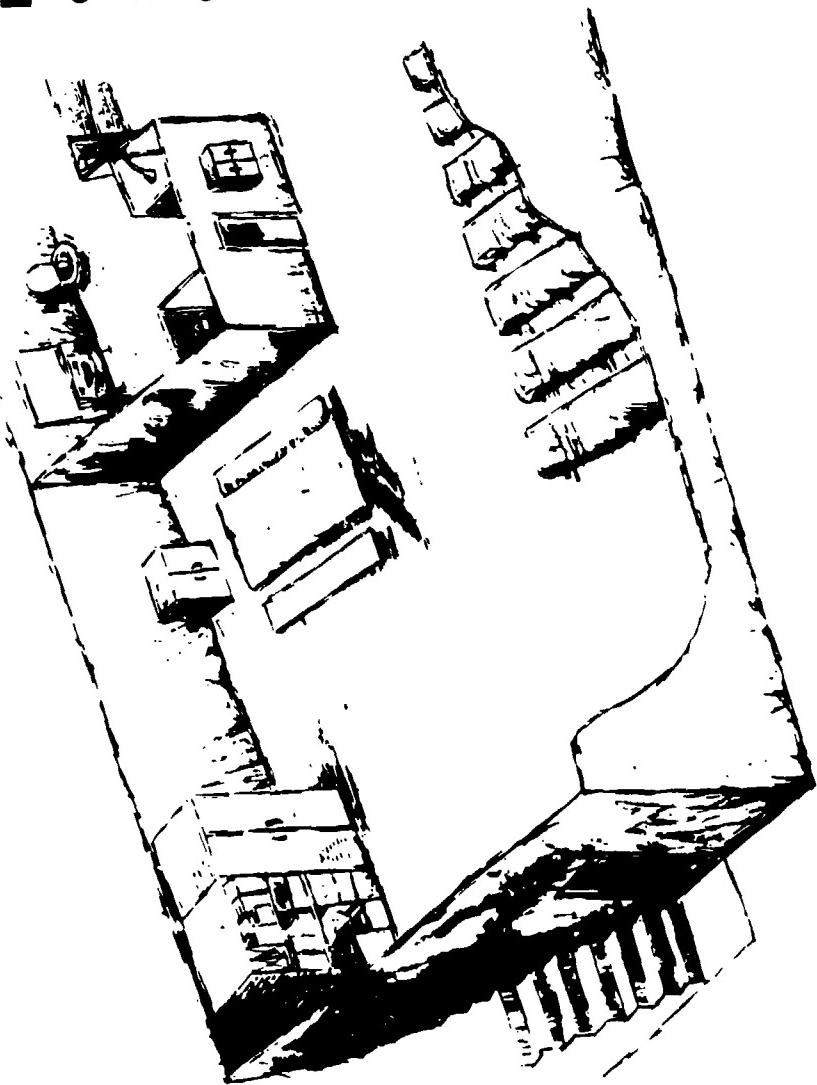
- **SHELTERING.**
AN OVERT BEHAVIOR WHOSE OBJECTIVE IS TO PARTIALLY OR COMPLETELY PROTECT THE INDIVIDUAL FROM THE PHYSICAL EFFECTS OF AN INCIDENT.
- **PROPENSITY FOR ATTRITION.**
AN EXPECTED VALUE, EXPRESSED AS A PERCENTAGE EXTRAPOLATED FROM EMPIRICAL DATA, INDICATING TENDENCIES TO LEAVE SHELTER.

BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

PREATTACK

BEHAVIORAL PROFILE

- **AWARE**
- **CONCERNED**
- **UNFOCUSSED ACTIONS**

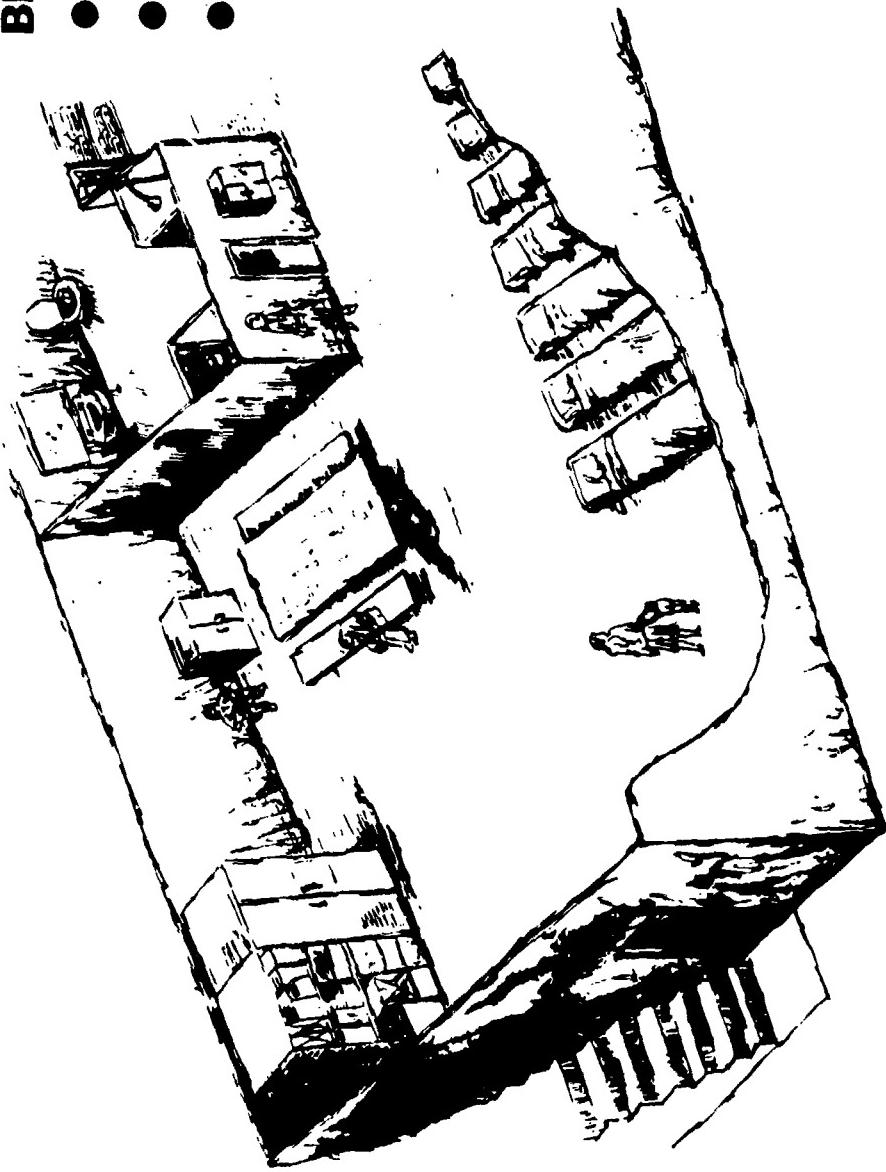


BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

ATTACK

BEHAVIORAL PROFILE

- DAZED
- MUTED
- STEREOTYPICAL

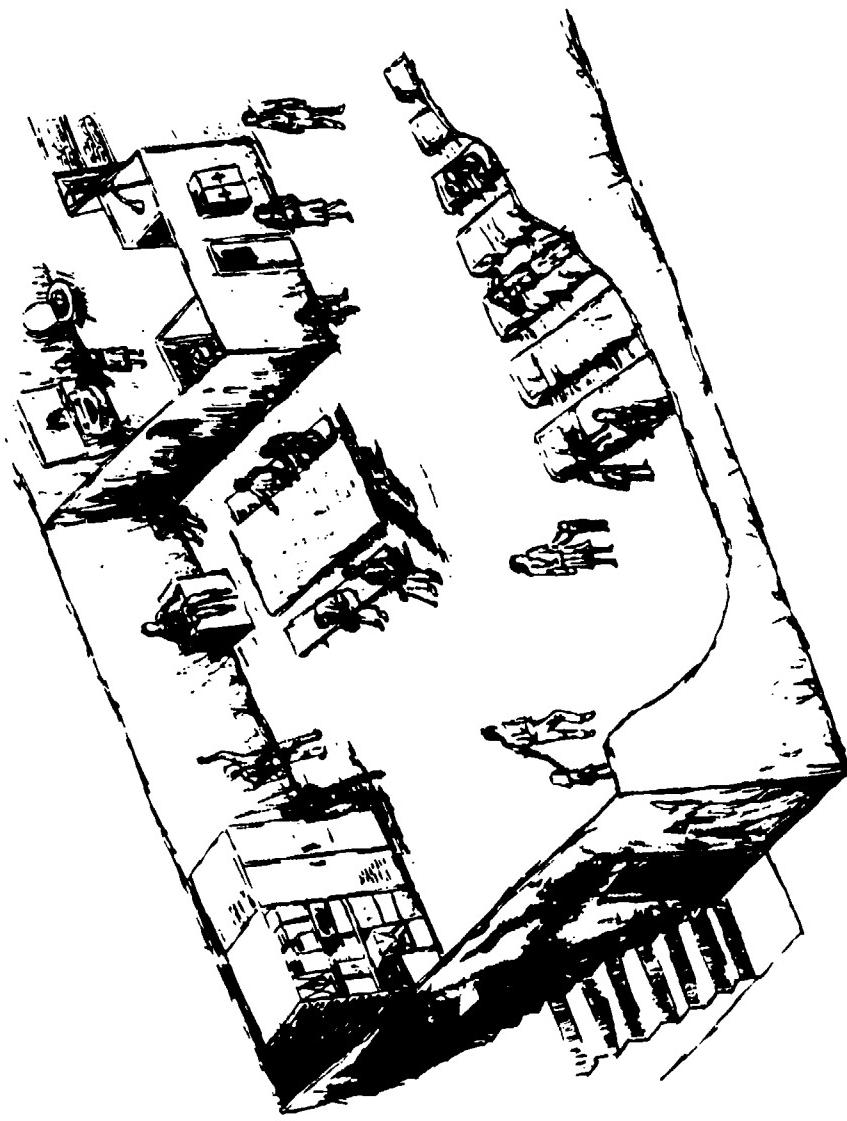


**BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY**

**24 HOURS
DAY 1**

BEHAVIORAL PROFILE

- FUZZY
- ANGER/FRUSTRATION
- RIGIDITY



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BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

24 HOURS DAY 1



Δ CUM 5.9

Δ CUM 11.6

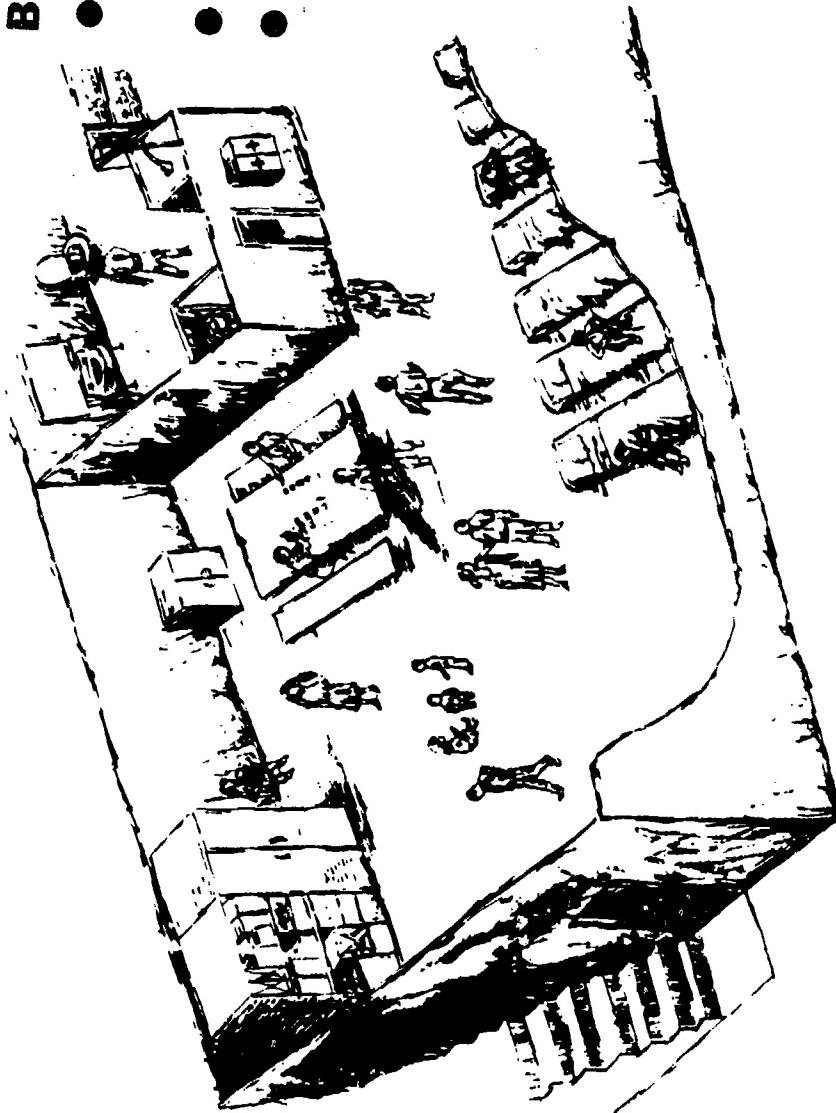
CUM 11.6

BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

**48 HOURS
DAY 2**

BEHAVIORAL PROFILE

- **DIFFICULTY SOLVING
PROBLEMS**
- **FEAR/ANXIETY**
- **MANIFESTATIONS OF
BOREDOM**

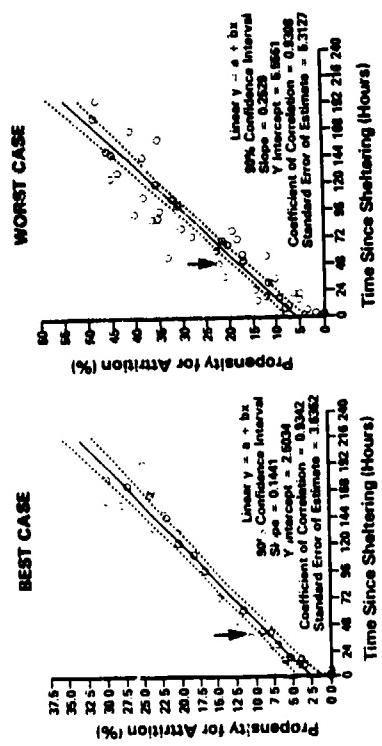


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BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

48 HOURS
DAY 2

- REASONS FOR LEAVING**
- PHYSICAL EFFECTS
 - PHYSIOLOGICAL NEEDS
 - LACK OF COMMUNICATION
 - LACK OF DIRECTION
 - PRIMARY GROUP SEPARATION



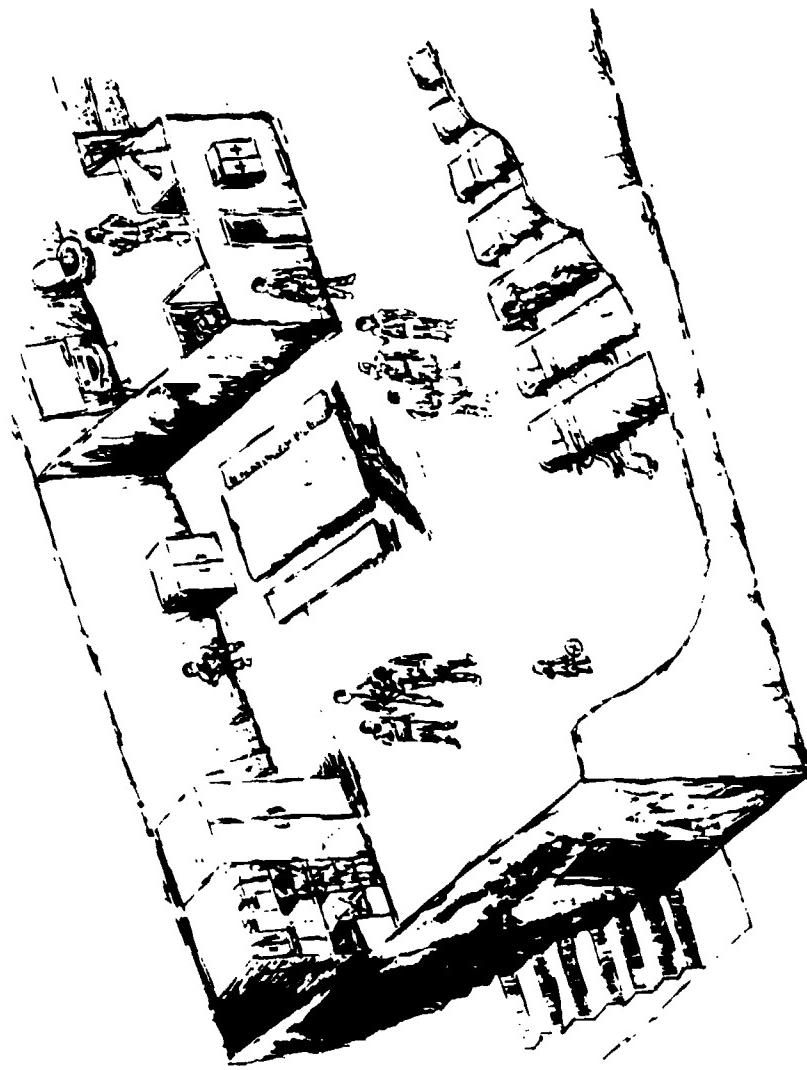
Δ CUM 3.5 Δ CUM 9.4 Δ CUM 6.1 CUM 17.7

**BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY**

**72 HOURS
DAY 3**

BEHAVIORAL PROFILE

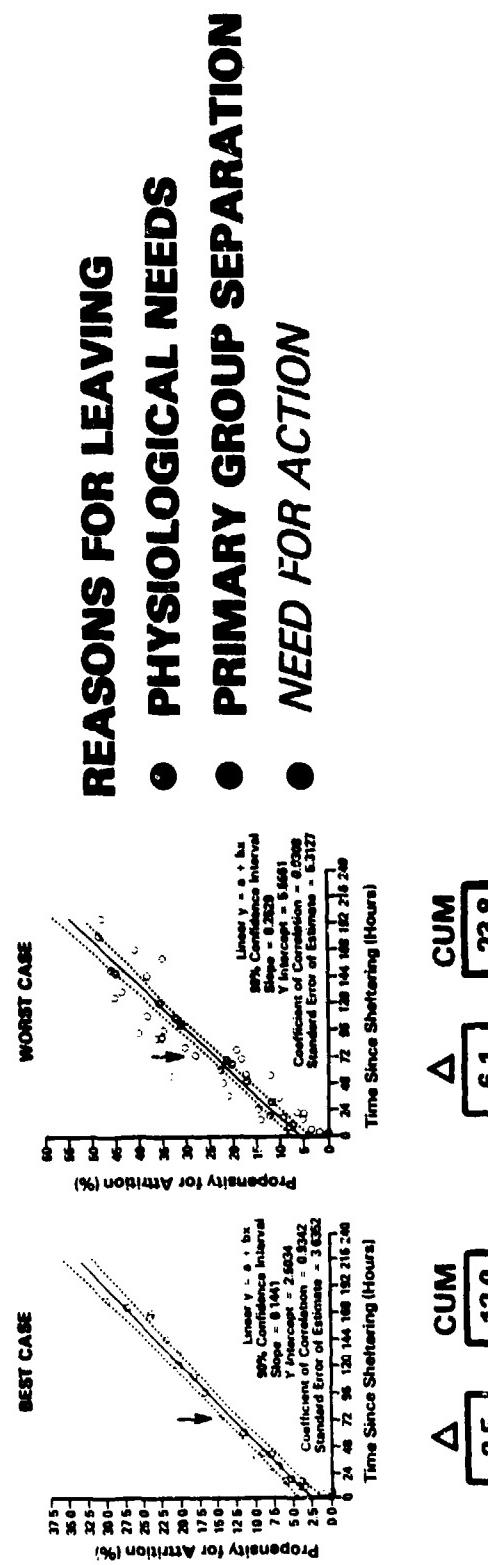
- COGNITIVE CLEARING
- ANXIETY REDUCTION
- TENSION REDUCTION



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BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

72 HOURS
DAY 3

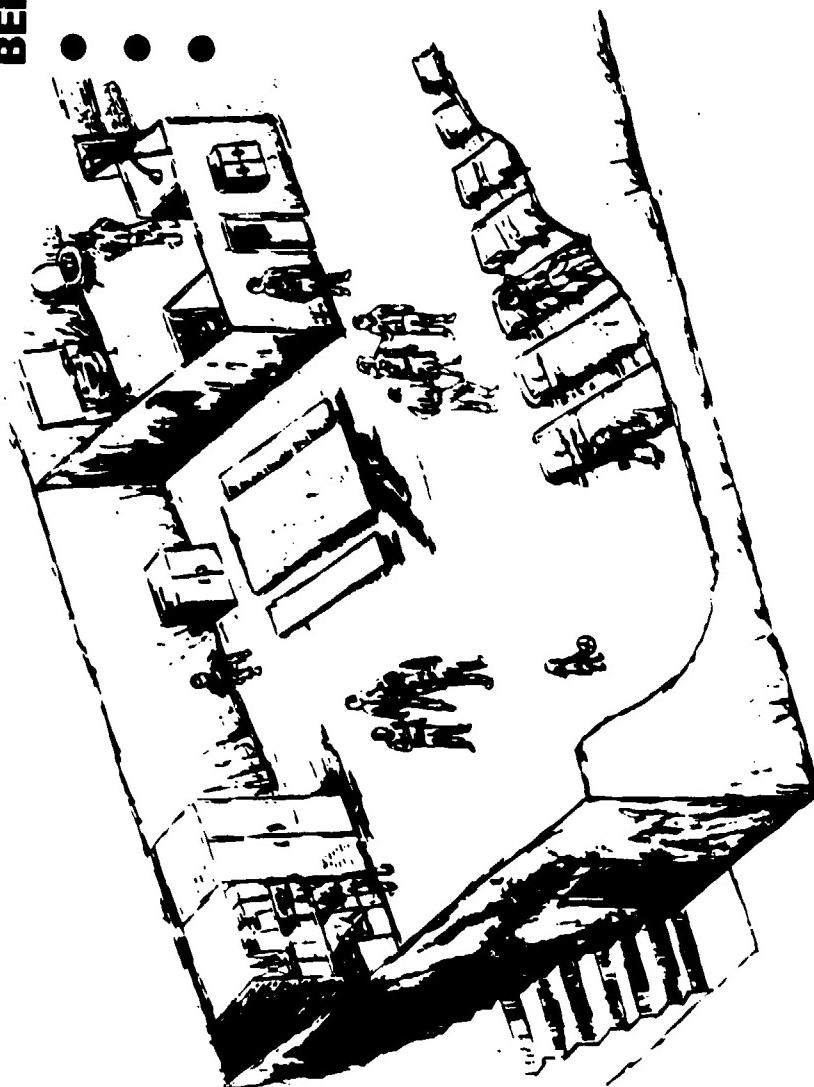


**BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY**

**96 HOURS
DAY 4**

BEHAVIORAL PROFILE

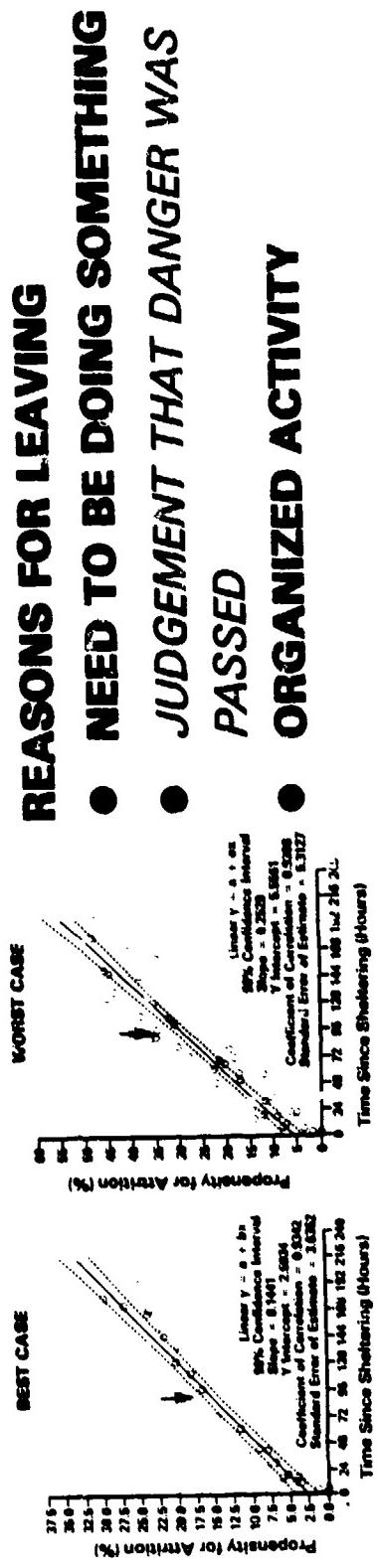
- **NORMAL**
- **TENSION/IRRITABILITY**
- **REACTIONS TO FORCED
IDLENESS**



BEHAVIORAL ASPECTS OF FALLOUT SHELTER STUDY

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96 HOURS
DAY 4



Δ CUM 16.3
 Δ CUM 4.3

Δ CUM 6.0

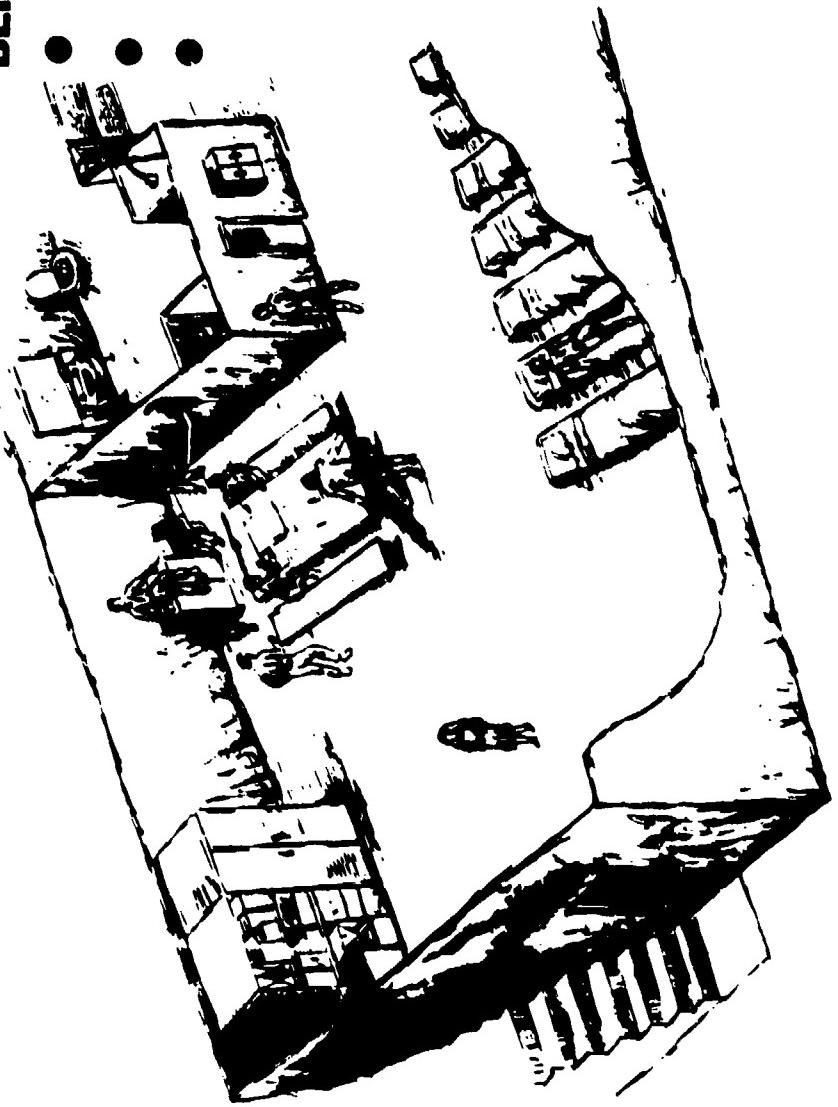
CUM 29.8

*BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY*

**120 HOURS
DAY 5**

BEHAVIORAL PROFILE

- **NORMAL**
- **IRRITABILITY**
- **ORGANIZED ACTIVITY**

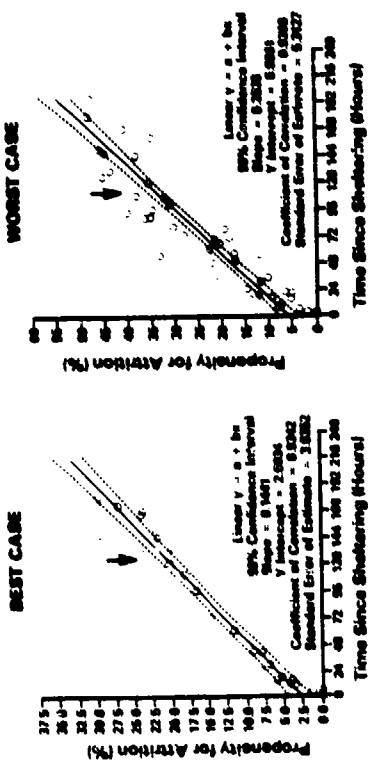


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BEHAVIORAL ASPECTS OF FALL OUT SHELTER STAY

120 HOURS DAY 5

- **REASONS FOR LEAVING**
 - **LACK OF COMMUNICATION**
 - **INDEPENDENT JUDGEMENT**
 - **PRIMARY GROUP CONCERN**
 - **PHYSIOLOGICAL NEEDS**



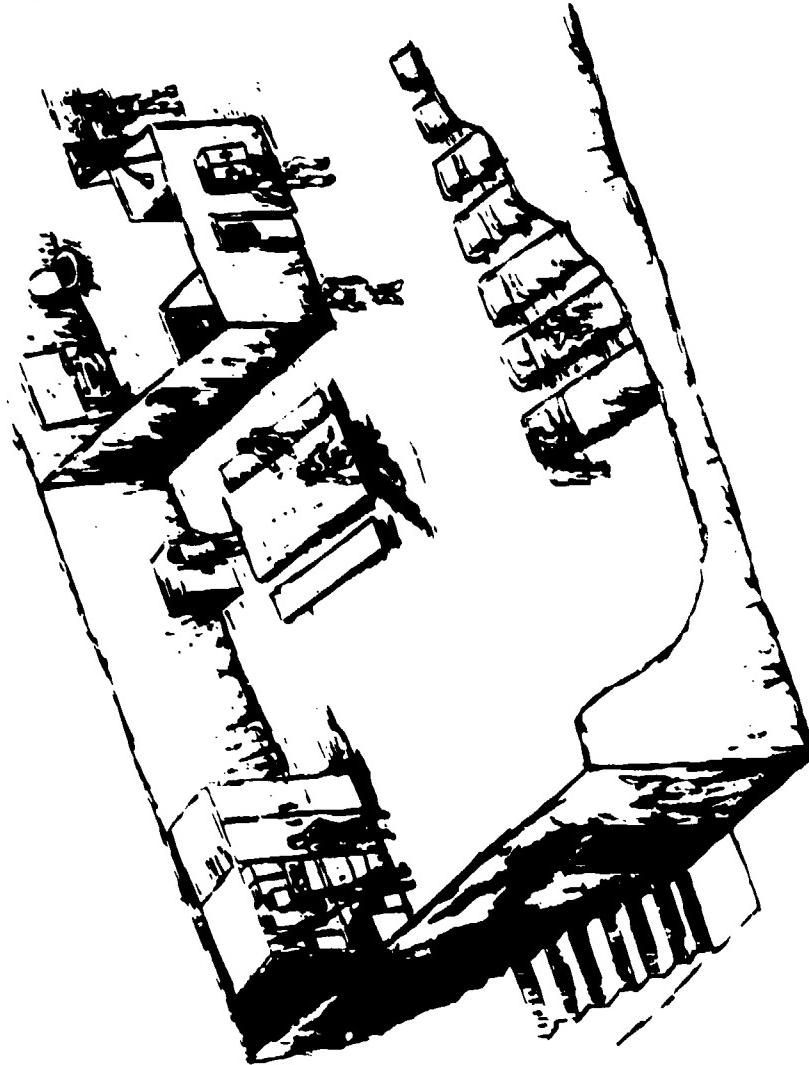
CUM Δ 35.9
CUM Δ 6.1
CUM Δ 19.8
CUM Δ 3.5

**BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY**

**144 HOURS
DAY 6**

BEHAVIORAL PROFILE

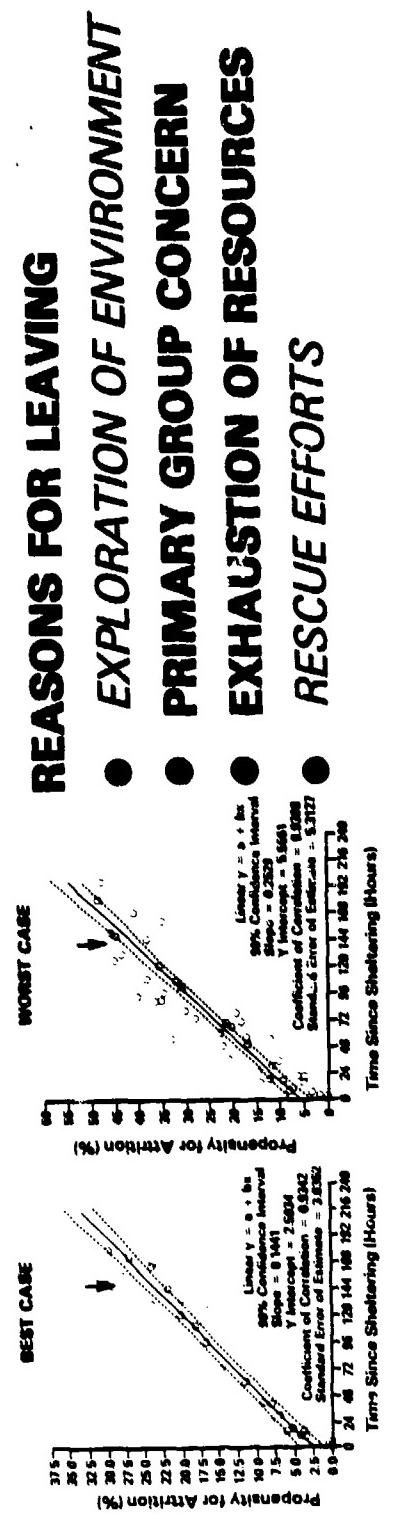
- **NORMAL**
- **ACCEPTANCE**
- **DIFFERENTIATION OF ACTIVITIES**



BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

**144 HOURS
DAY 6**

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3.4

CUM 42.0

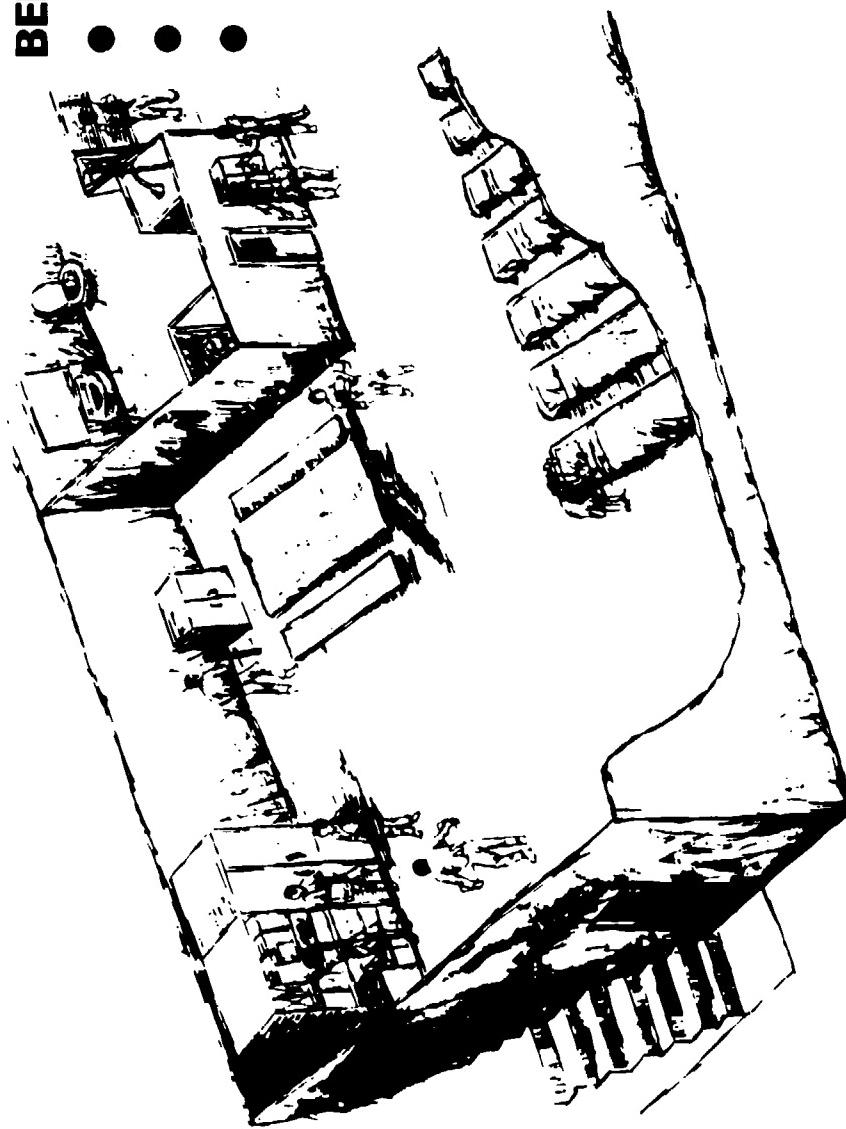
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**BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY**

**168 HOURS
DAY 7**

BEHAVIORAL PROFILE

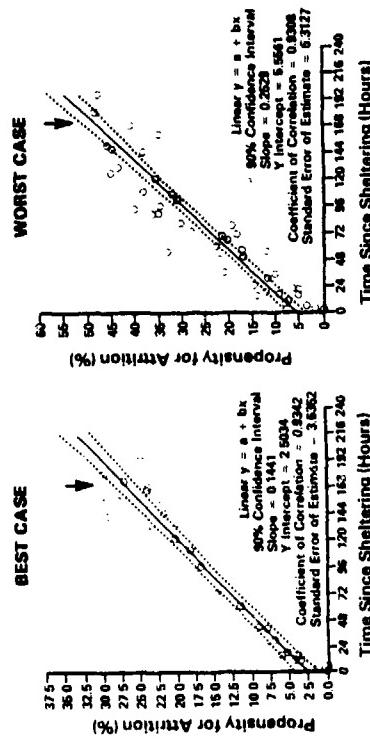
- *NORMAL*
- *NORMAL*
- *DIRECTED ORGANIZED ACTIVITIES*



BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

**168 HOURS
DAY 7**

- **REASONS FOR LEAVING**
- **PERCEPTION OF DANGER OVER**
- **NEED FOR ACTION**
- **RE-ESTABLISH COMMUNITY**
- **EXHAUSTION OF PHYSICAL
RESOURCES**



BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

MAJOR FINDINGS

- QUANTITATIVE ESTIMATES OF FALLOUT SHELTER
- POPULATIONS CAN BE OBTAINED
- LENGTH OF FALLOUT SHELTER STAY IS DEPENDENT ON
- A VARIETY OF VARIABLES
- THE MOST SENSITIVE OF THESE VARIABLES IS DEGREE OF PREPAREDNESS. ($\Delta = 22\%$)
- POST ATTACK BEHAVIOR WILL BE WITHIN THE RANGE CONSIDERED "NORMAL"
- APPLICATION TO SOVIET POPULATIONS SHOULD, MOST REASONABLY, BE IN TERMS OF BEST AND WORST CASES
- THE RESULTS OF THIS ANALYSIS APPEAR TO INCREASE THE CREDIBILITY OF CURRENT FALLOUT SHELTER STAY TIME ESTIMATES.
- A BEHAVIORAL ANALYSIS ADDS A MEANINGFUL DIMENSION TO STUDIES OF FALLOUT SHELTER STAY TIMES.

*BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY*

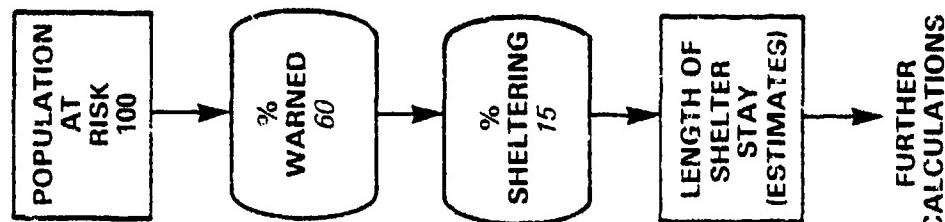
**APPLICATION TO
SOVIET POPULATIONS**

- DATA GENERALIZES ACROSS CULTURE AND TIME.
- SOVIET POPULATIONS ARE PROBABLY BETTER PREPARED THAN THEIR AMERICAN COUNTERPARTS.
- SOVIET POPULATIONS ARE PROBABLY NOT AS PREPARED AS THEIR LITERATURE INDICATES.
- IN THE ABSENCE OF DEFINITIVE INFORMATION, A COMPARISON OF BEST AND WORST CASES IS REASONABLE.

**BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY**

USAGE

**POPULATION
AT
RISK**
100



TBILISI, SOVIET GEORGIA

1,100,000
↓
600,000
↓
150,000

Example:

ATTRITION EQUATIONS	
BEST	$y = 0.14x + 2.5$
WORST	$y = 0.25x + 5.6$

POPULATION REMAINING IN SHELTERS

CASE	24 HRS	48 HRS	72 HRS	96 HRS	120 HRS	144 HRS	168 HRS
BEST	141,000	136,000	130,000	125,000	120,000	115,000	110,000
WORST	133,000	123,000	114,000	105,000	96,000	87,000	78,000

**FURTHER
CALCULATIONS**

*BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY*

**WHAT WE
CAN KNOW**

- WHAT WE CAN KNOW?
 - DISASTER PROFILE
 - SIMULATED SHELTER BEHAVIOR
 - EXTRAPOLATED QUANTITATIVE DATA

- WHAT WE CAN SPECULATE ABOUT?
 - APPLICATION TO SOVIET POPULATIONS
 - INTERPRETATION

- WHAT WE CAN'T KNOW
 - WHAT WOULD REALLY HAPPEN?

*BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY*

VARIABLES

- PHYSIOLOGICAL
- SHELTER SPACE
- SHELTER TYPE
- WARNING
- TRAINING
- SHELTER MANAGEMENT
- EVACUATION POSTURE
- COMMUNICATION

BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

SOURCES DATA TYPE

SOURCES

- DISASTER RESEARCH
- SHELTER RESEARCH
- INTELLIGENCE

DATA TYPES

- OBSERVATIONS
- INTERVIEWS
- QUESTIONNAIRES

*BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY*

CRITERIA

- BRIEF, INTENSE EXPENDITURE OF ENERGY
- BEFORE ARRIVAL OF AID
- DATA COLLECTED WITHIN 30 DAYS OF INCIDENT
- RELIABLE DATA COLLECTOR
- DATA COLLECTED WITHIN IMPACT AND FRINGE AREAS
- QUANTITATIVE DATA AVAILABLE

BEHAVIORAL ASPECTS OF FAIR OUT SHELTER STAY

SOURCES

<u>SOURCE</u>	<u>NUMBER OF STUDIES</u>	<u>PERCENTAGE OF DATA</u>
● NAS/NRC/NORC	350	35
● DCPA	83	30
● OHIO STATE/DRC	200	20
● MISCELLANEOUS	45	15

**BEHAVIORAL ASPECTS
OF FALLOUT SHELTER STAY**

**SOURCES
DISASTER RESEARCH**

<u>DISASTER AGENTS</u>	<u>EVENTS STUDIED</u>	<u>FIELD STUDIES</u>	<u>INTERVIEWS AND QUESTIONNAIRES</u>	<u>REPORTS</u>
AIRPLANES	4	3	176	7
BLIZZARDS	3	2	19	2
EARTHQUAKES, ETC.	8	8	1,831	10
EPIDEMICS AND EPIDEMIC THREATS	5	5	2,487	7
EXPLOSIONS AND FIRES	13	13	678	11
FALSE ALERTS	6	7	2,953	7
FLOODS	12	16	3,319	27
HURRICANES AND TYPHOONS	12	9	364	9
MINE DISASTERS	2	3	297	5
TORNADOES	20	31	2,092	34
TOXICOLOGICAL SUBSTANCES	8	8	227	6
WORLD WAR II BOMBINGS	4	6	7,163	4
MISCELLANEOUS	6	—	18	4
TOTALS	103	114	21,624	121

BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

SOURCES/FALLOUT SHELTER RESEARCH

TABLE 1
**SUMMARY OF OCCUPANCY STUDIES,
SHELTEREES, AND MAN DAYS OF OCCUPANCY,
BY STUDY DURATION**

DURATION	NUMBER OF STUDIES	NUMBER OF STUDIES	SHELTEREES	MAN DAYS OF OCCUPANCY ^(a)
14 DAYS	10	585	8190	
8 DAYS	1	38	304	
7 DAYS	6	467	3269	
6 DAYS	1	144	864	
5 DAYS	2	145	725	
4 DAYS	2	63	252	
3 DAYS	4	152	456	
2 DAYS	24	3346	6692	
1 DAY	30	1672	1672	
12 HOURS	2	494	247	
TOTALS	82	7106	22671	

(a) NOT ADJUSTED FOR DEFECTS.

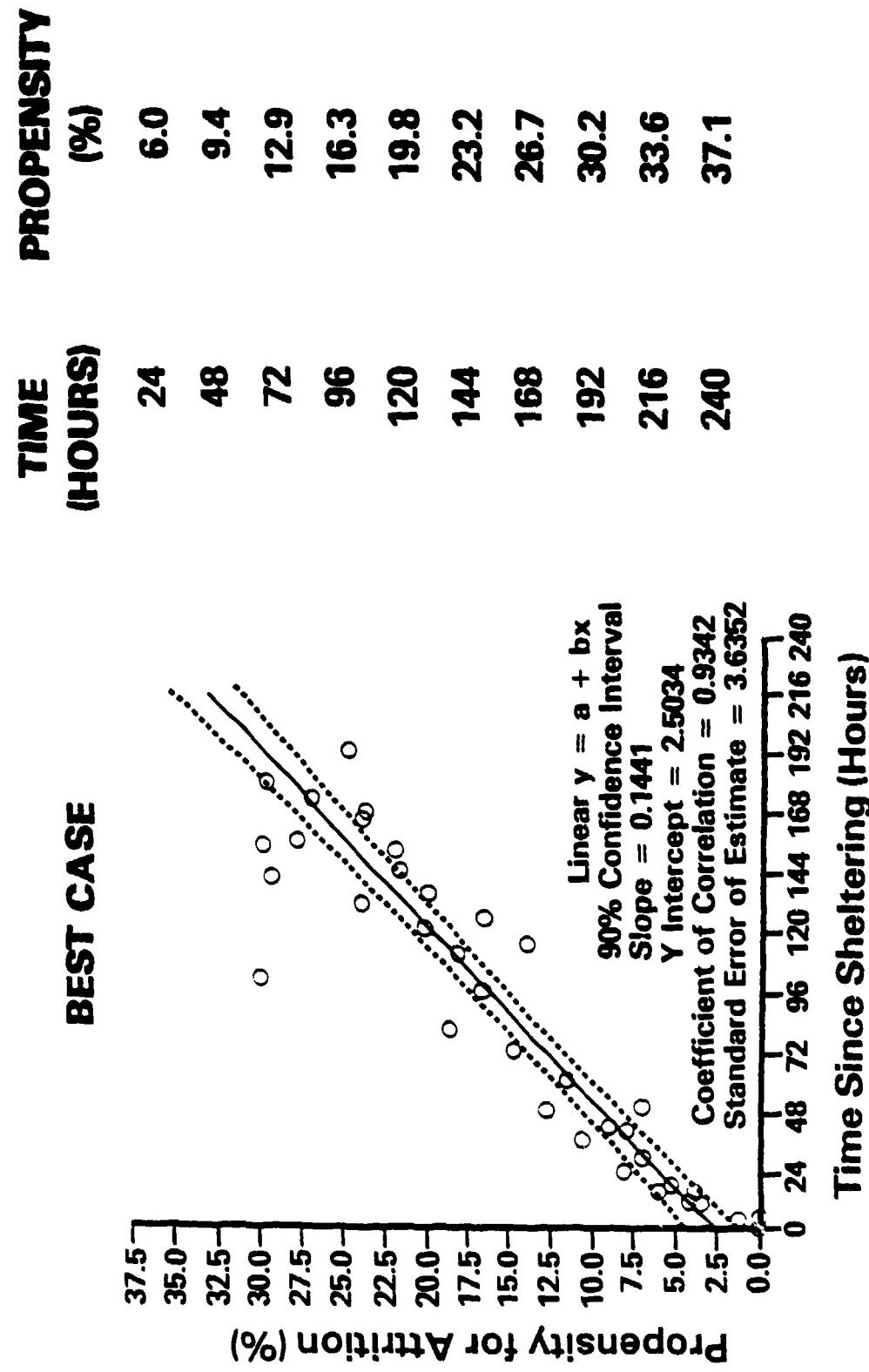
TABLE 2
**STUDIES BY POPULATION SIZE AND
MAN DAYS OF OCCUPANCY**

NUMBER OF SHELTEREES IN STUDY	NUMBER OF STUDIES	MAN DAYS OF OCCUPANCY
4, 5, 6, 7, 8, 10	12	198
15, 16, 18, 19, 20	12	213
21, 23, 24, 25, 26, 27	11	422
30, 34	14	2895
38, 40, 45, 51	13	1680
80	2	2240
99, 100, 104	7	5150
144, 160	2	1184
300, 307, 321	3	3391
390, 400, 402	3	1799
504	1	1038
722	1	1444
1046	1	1046
TOTALS	82	22671

From: Carr, F. and Garrett, R. State-of-the-Art. Shelter Management Research.
DCPA Report 23, October 1976.

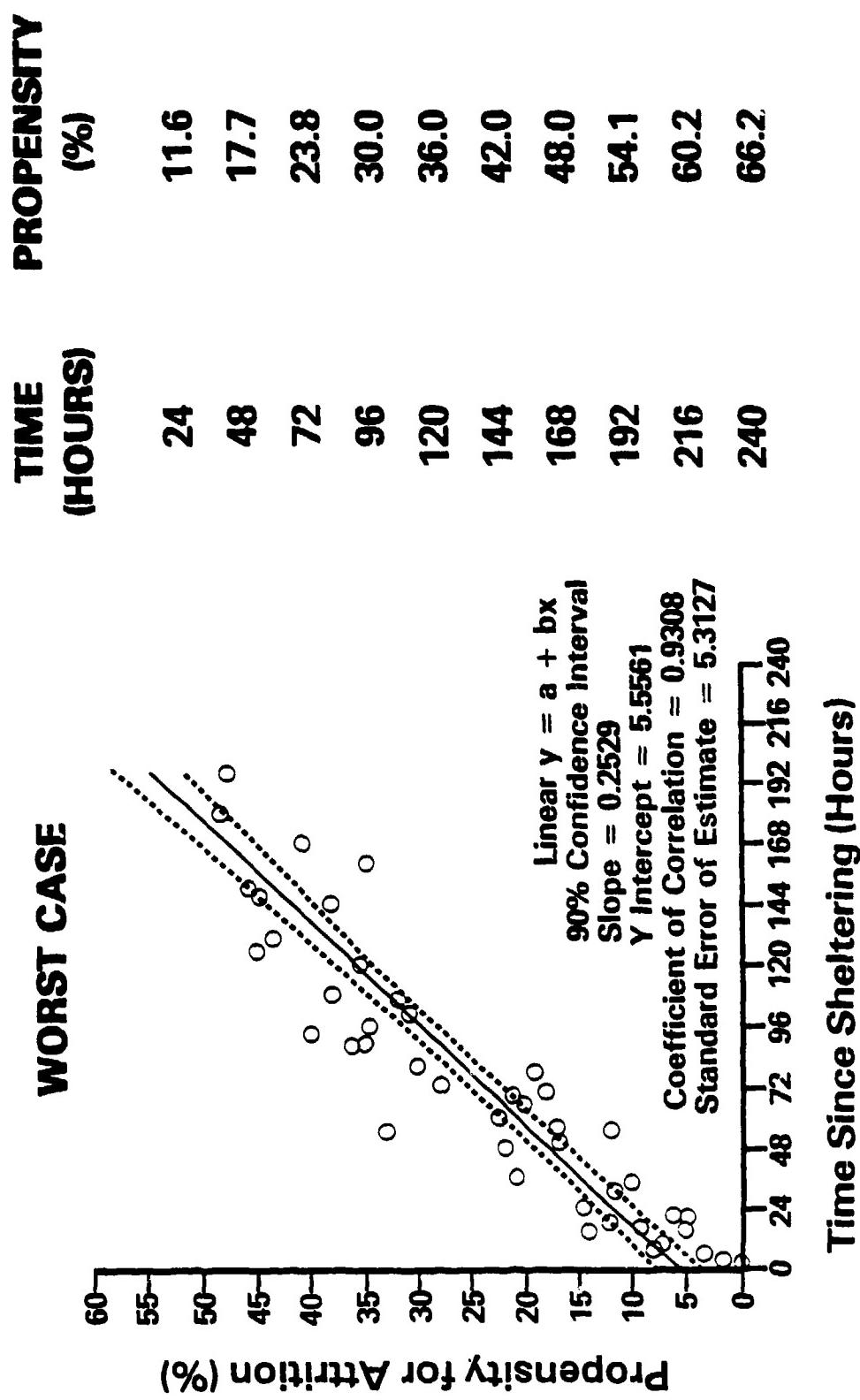
BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

DATA



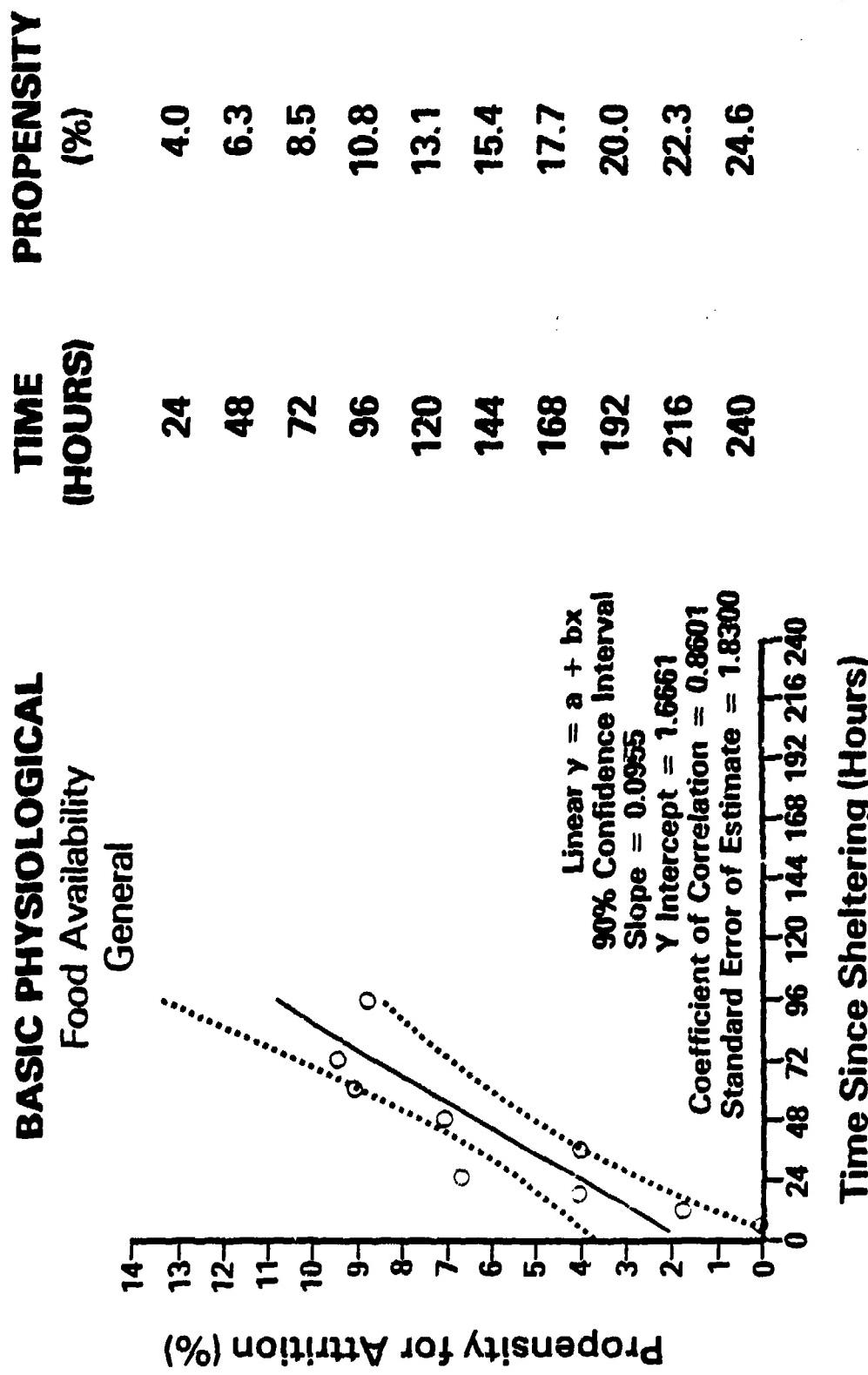
BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

DATA



BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

DATA



BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

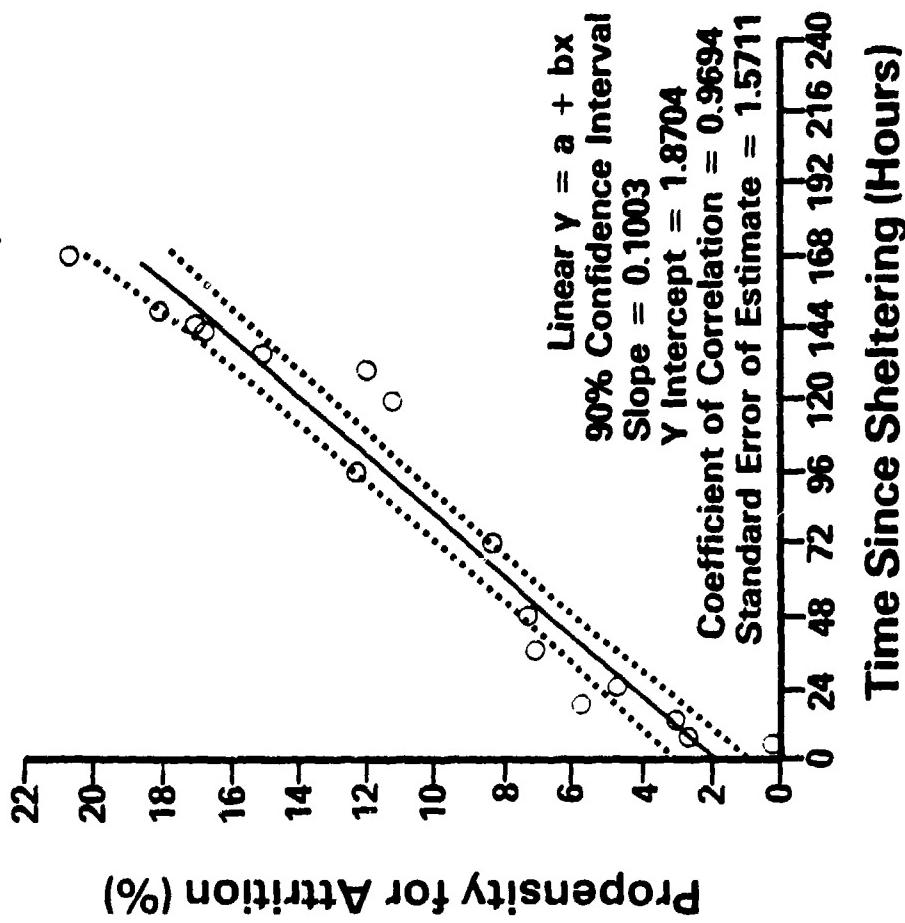
DATA

BASIC PHYSIOLOGICAL

Food Availability
1000 Cal./Day

TIME (HOURS)

TIME (HOURS)	PROPENSITY (%)
24	4.2
48	6.7
72	9.1
96	11.5
120	13.9
144	16.3
168	18.7
192	21.1
216	23.5
240	25.9



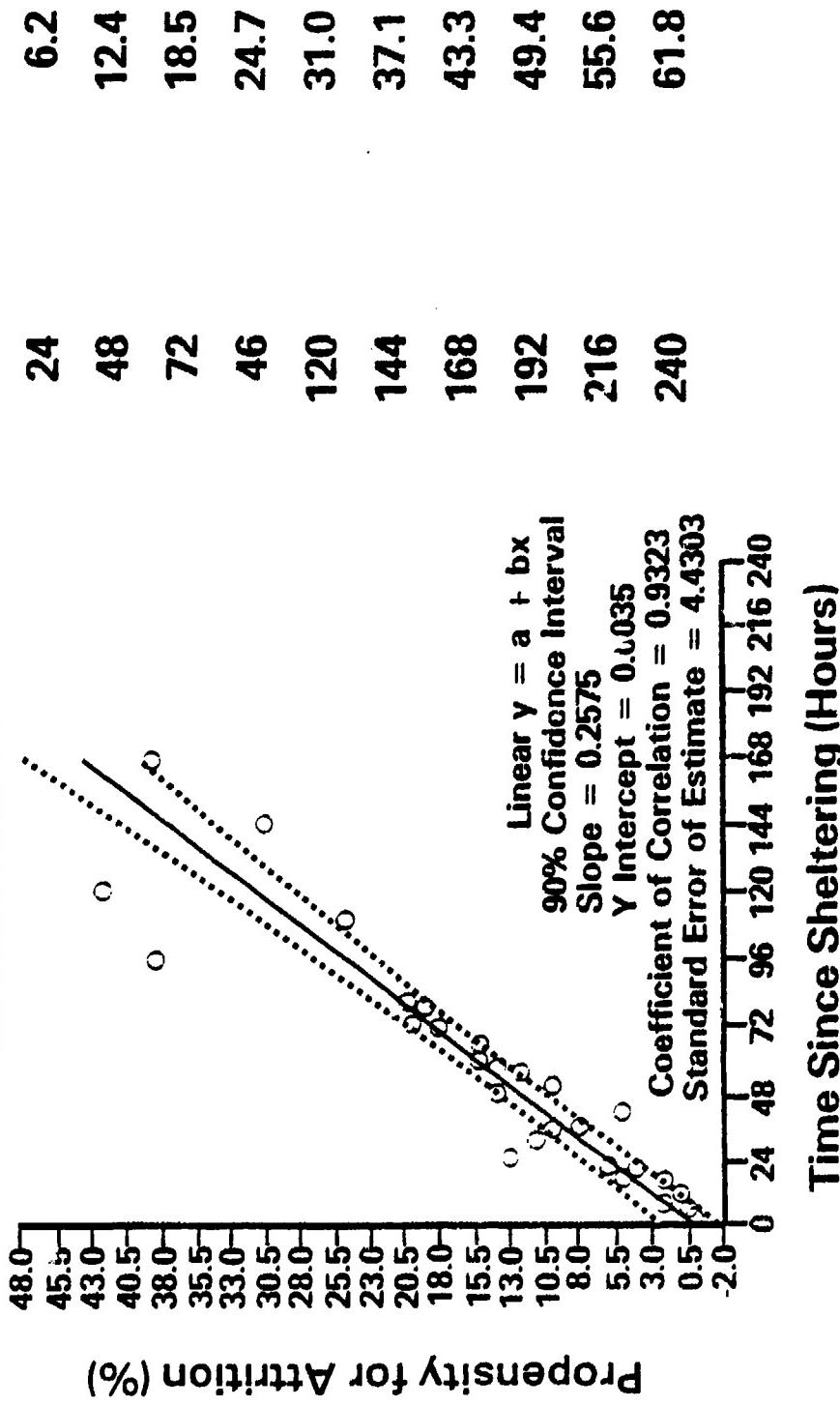
BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

DATA

BASIC PHYSIOLOGICAL

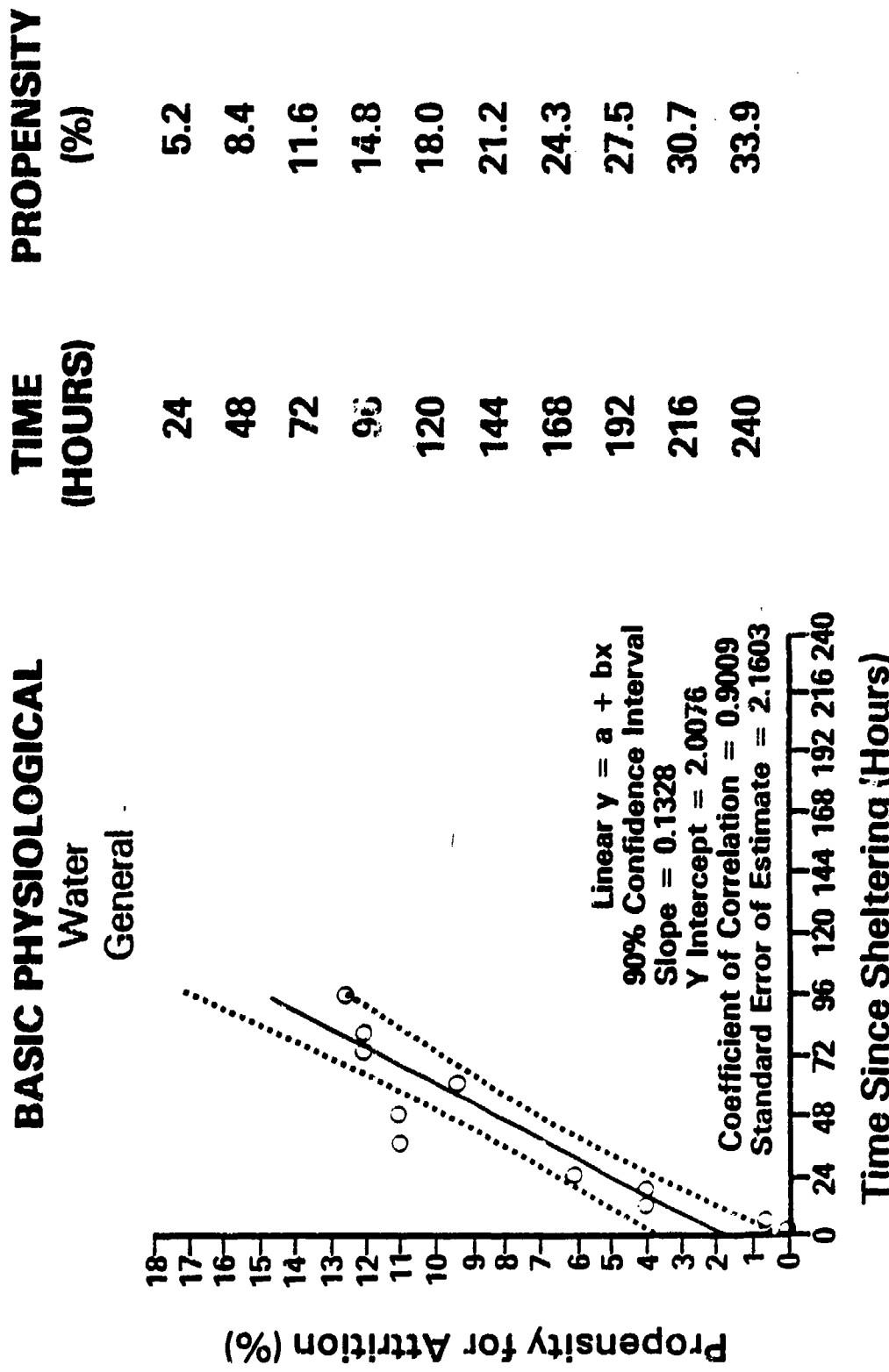
Food Availability
No Food Available

PROPENSITY (%)



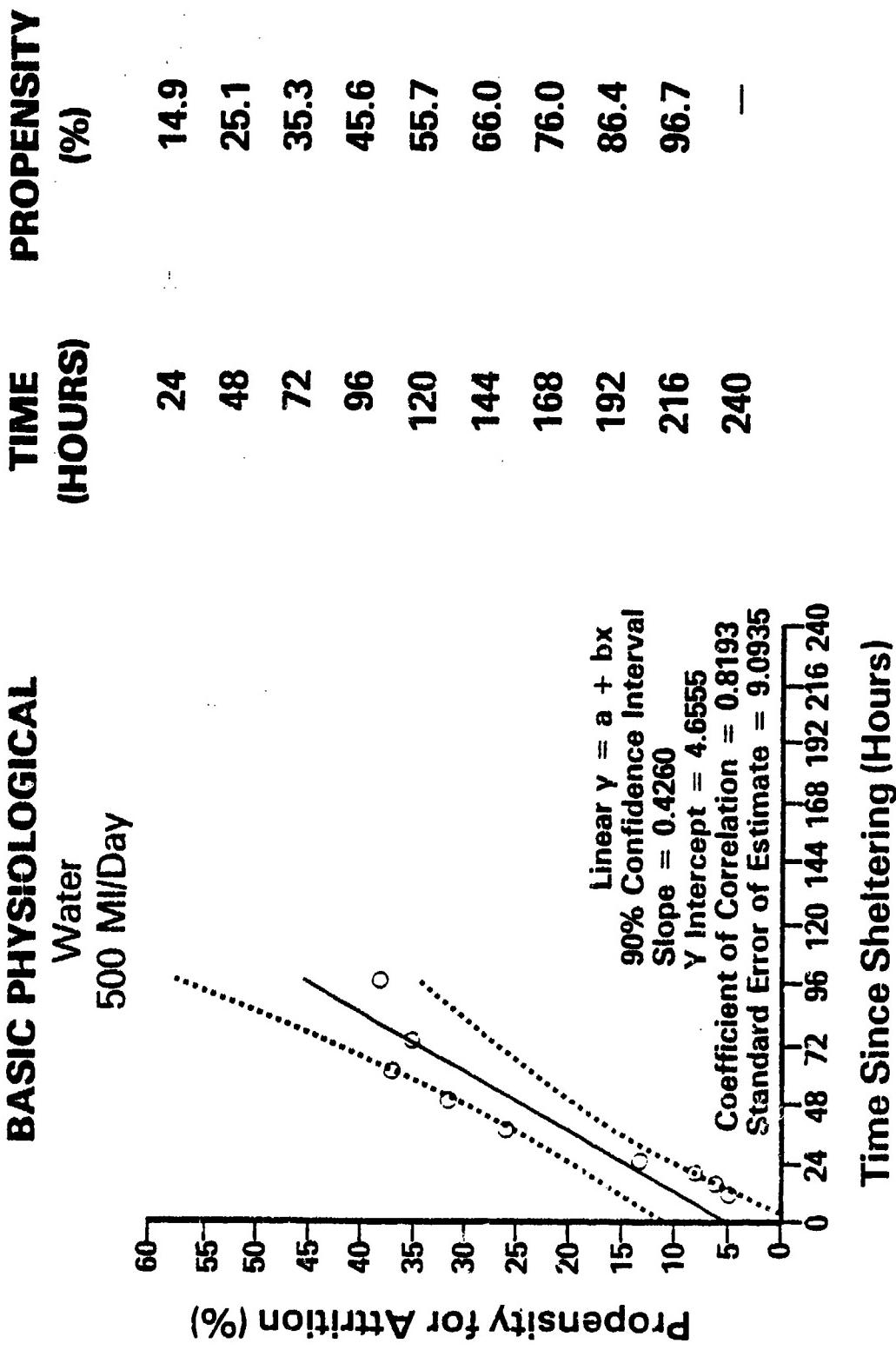
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DATA



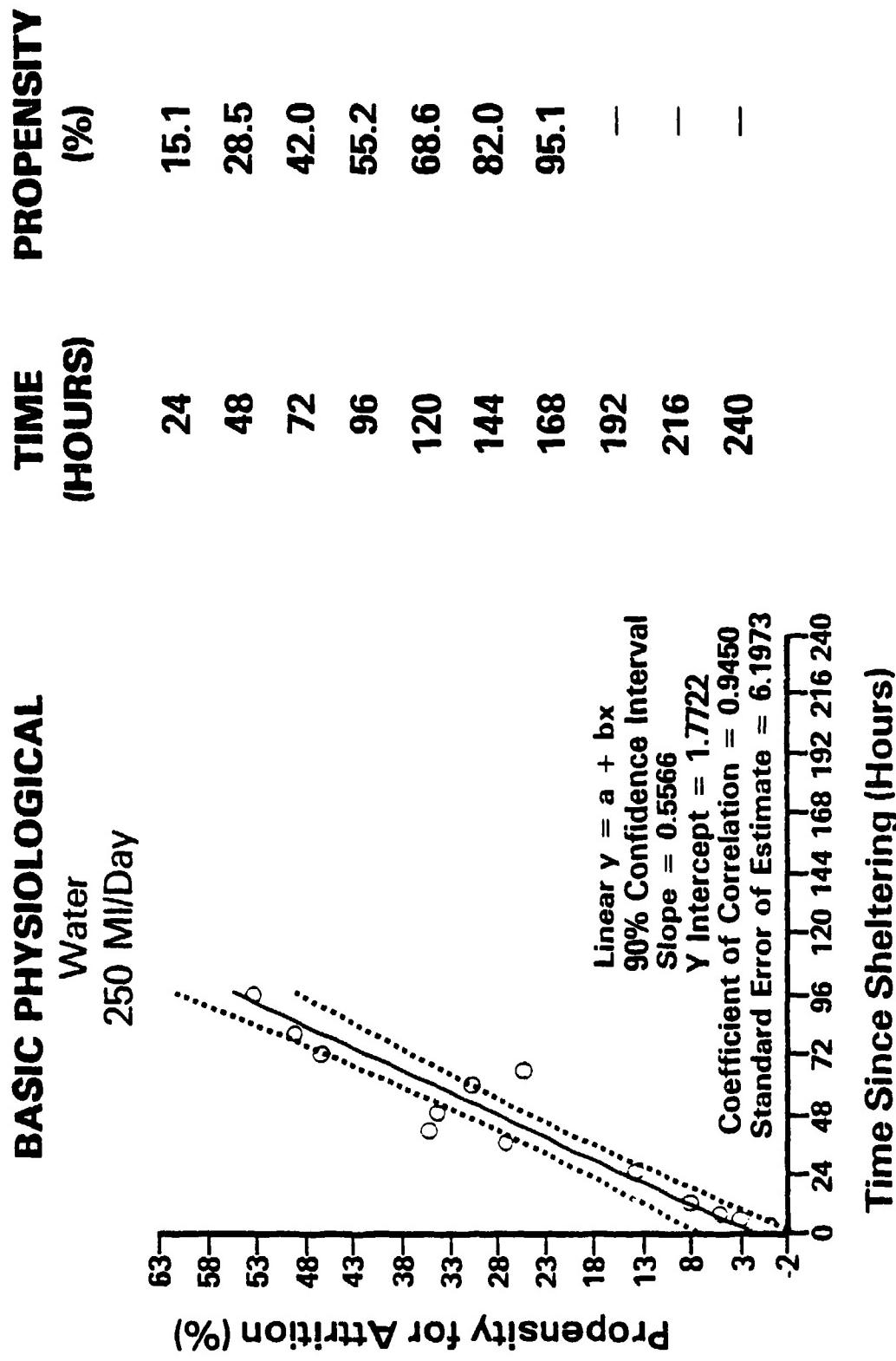
BEHAVIORAL ASPECTS OF FALLOUT SHELTER STAY

DATA



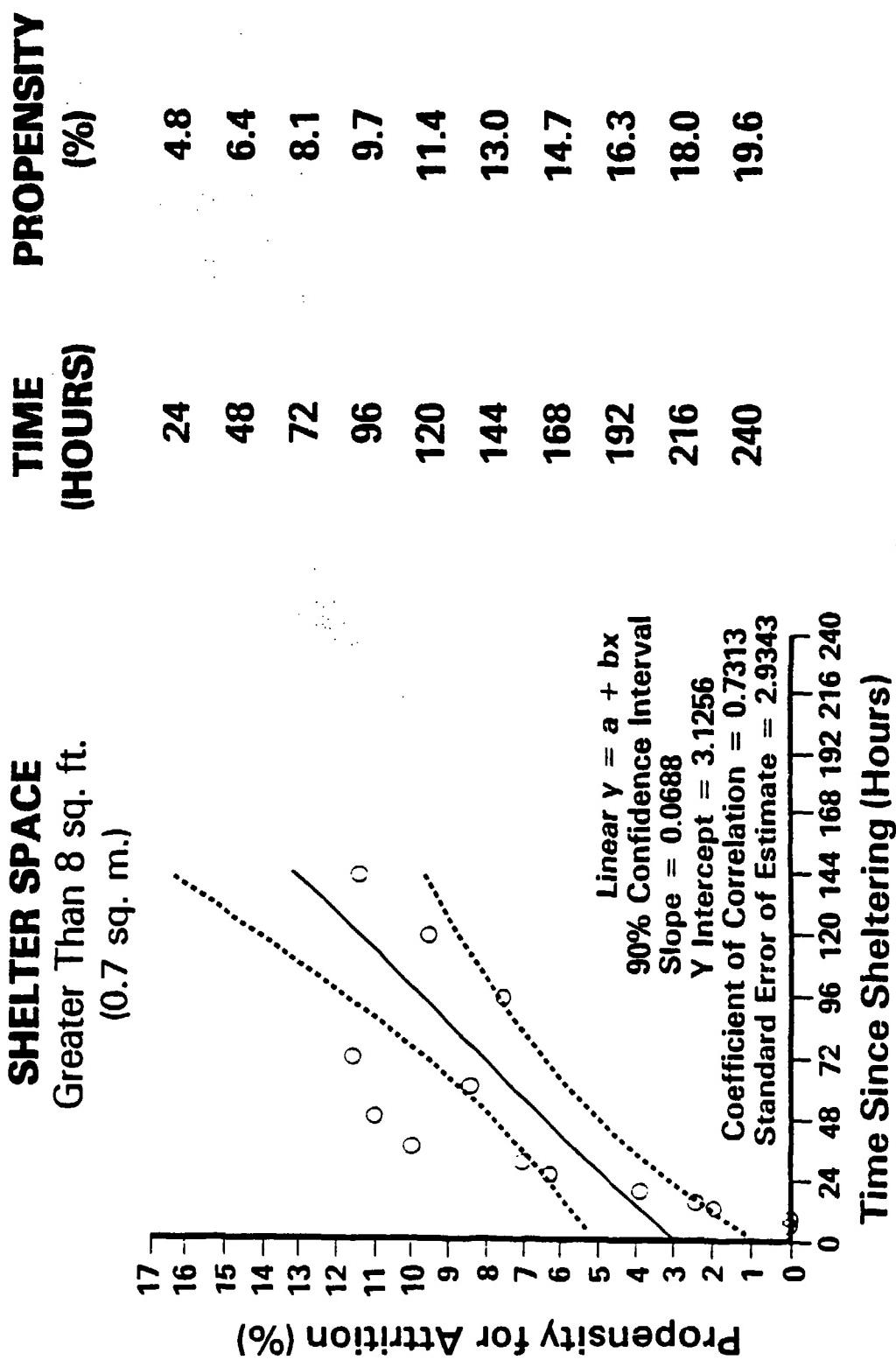
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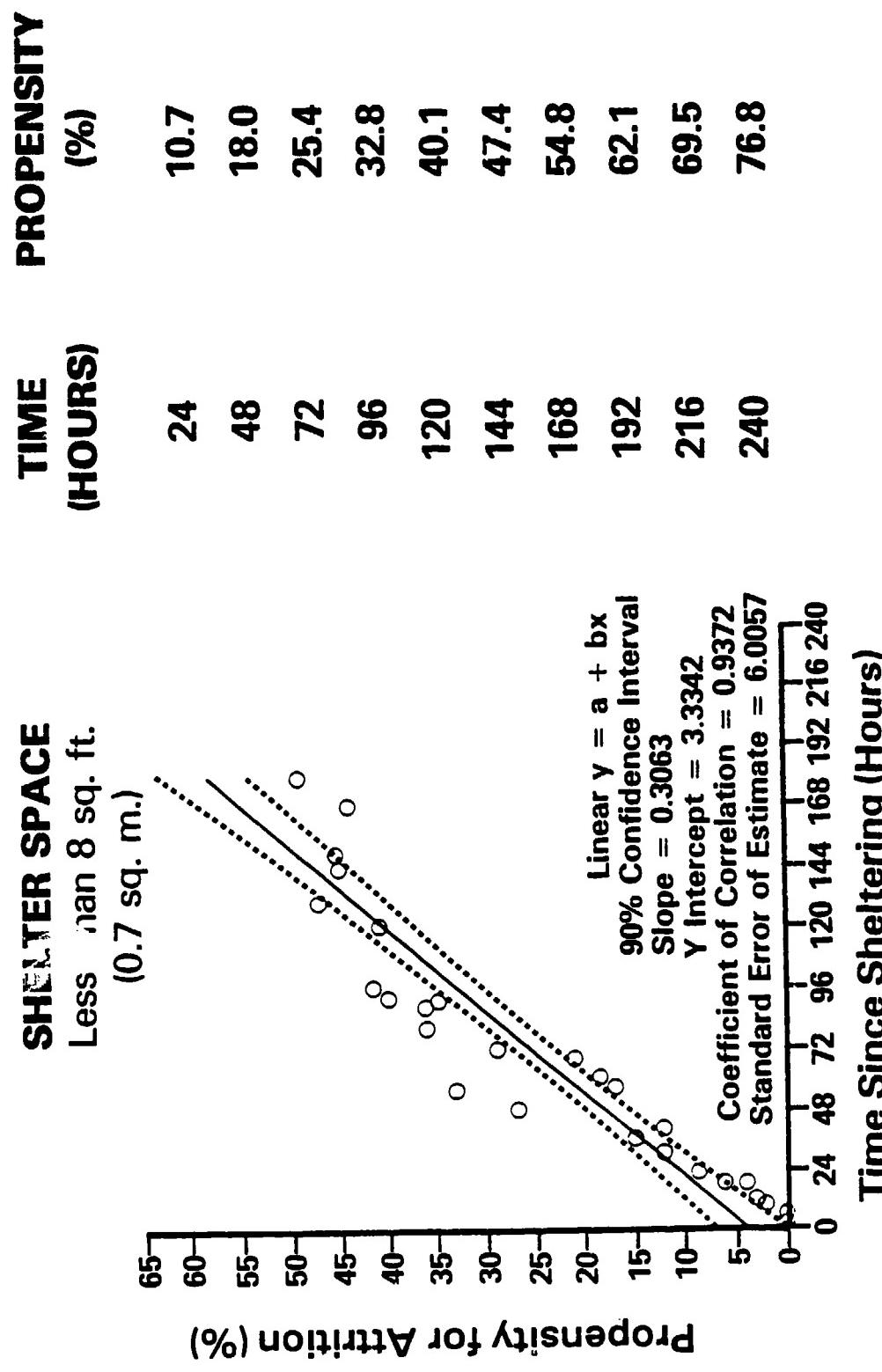
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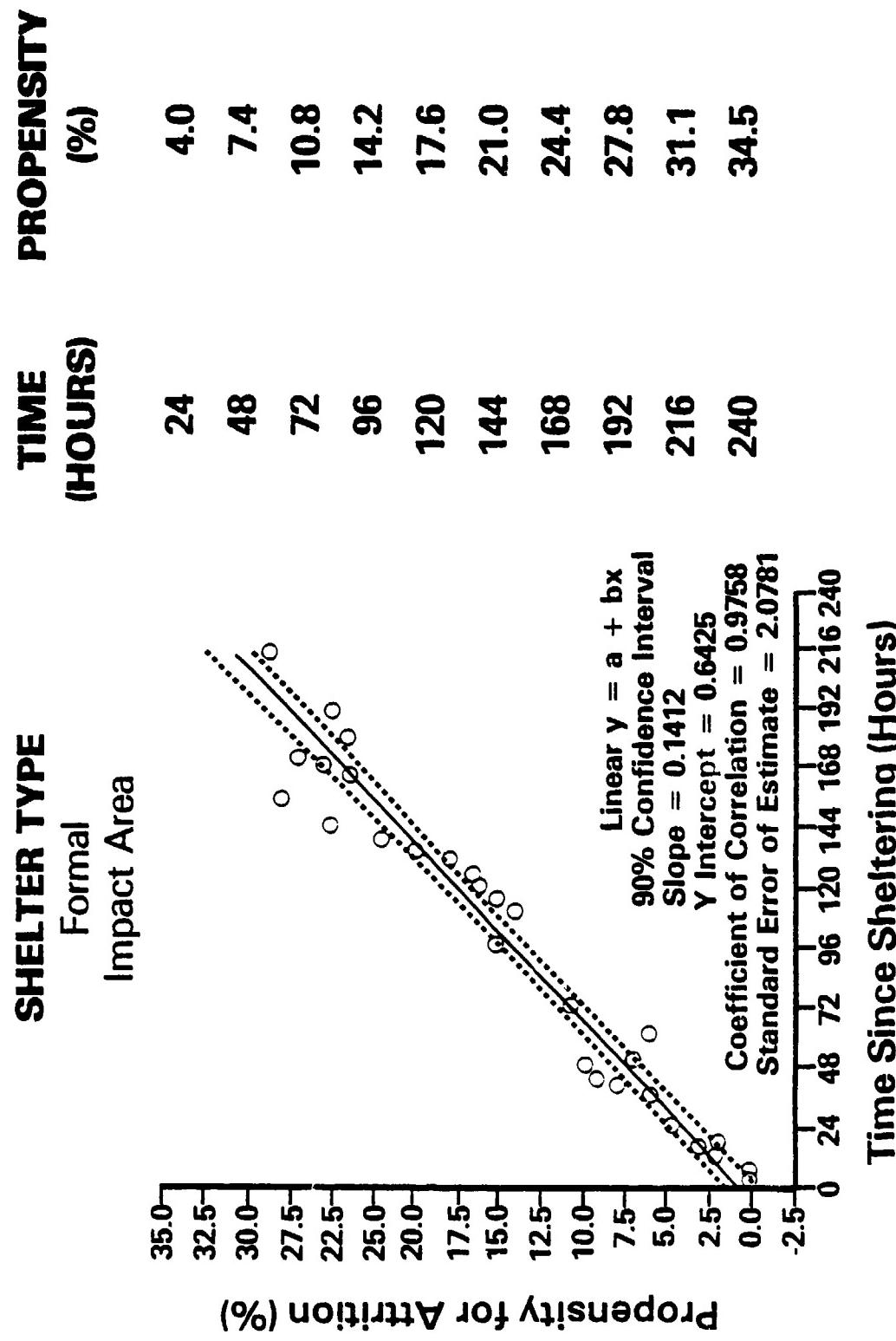
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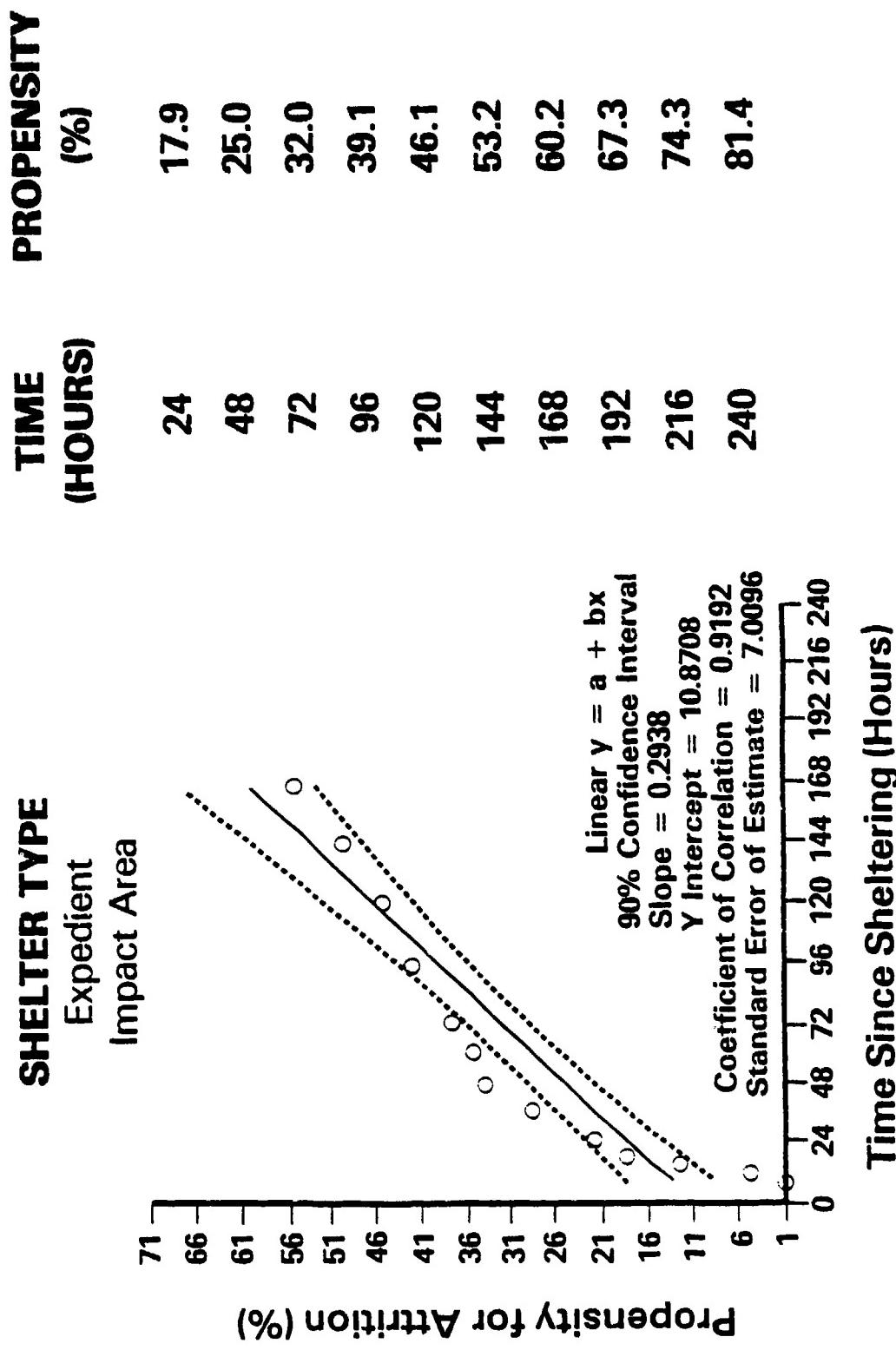
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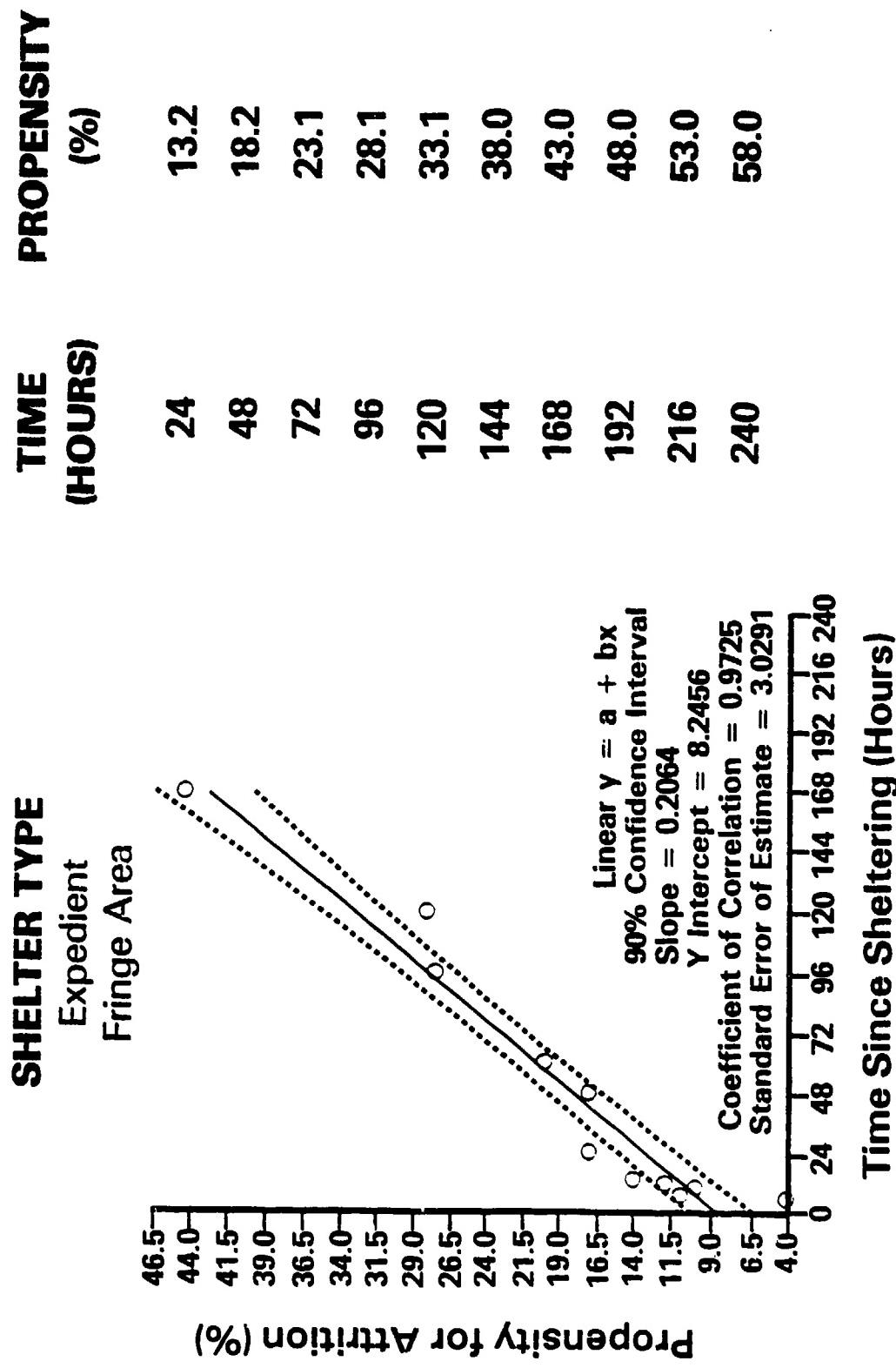
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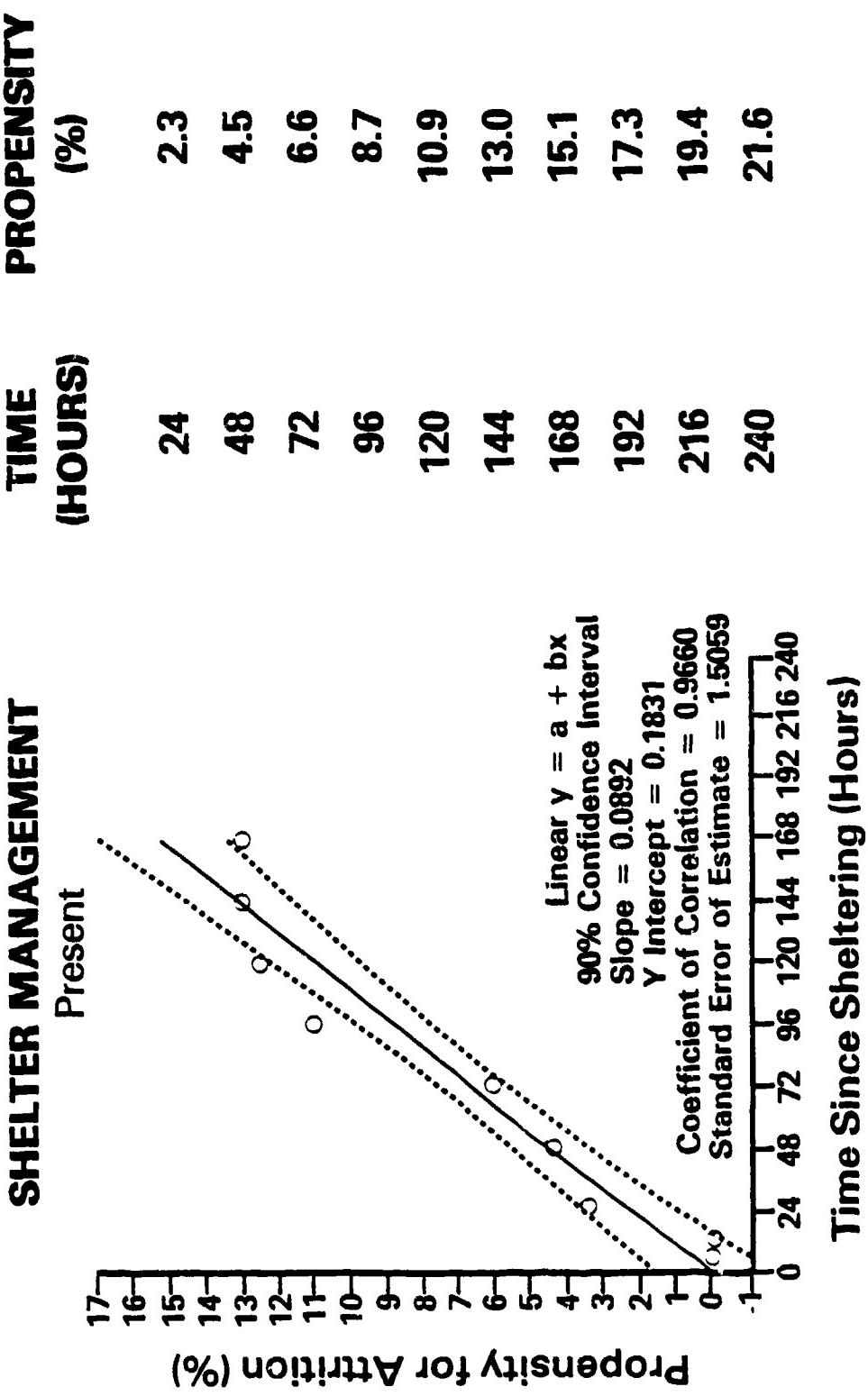
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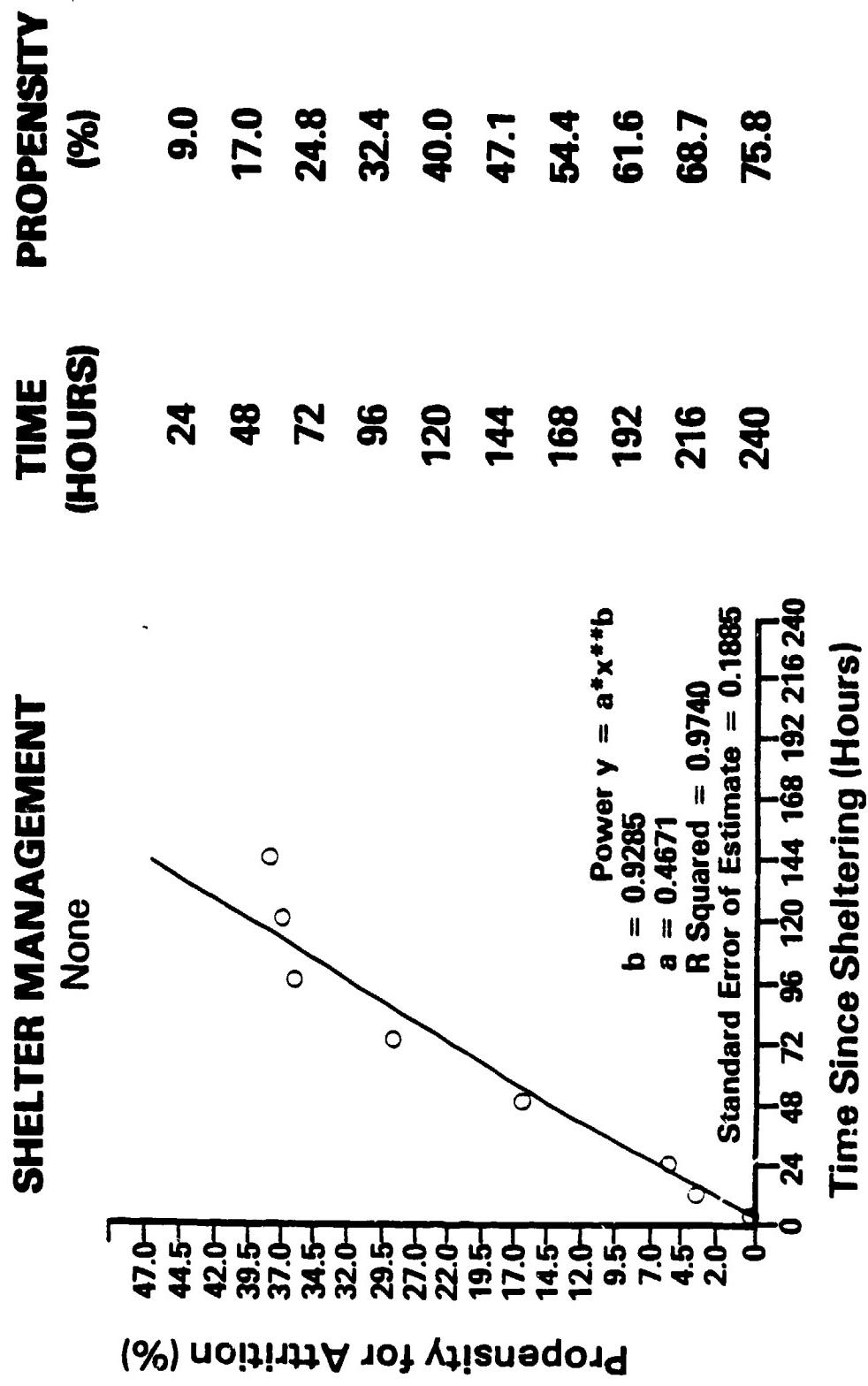
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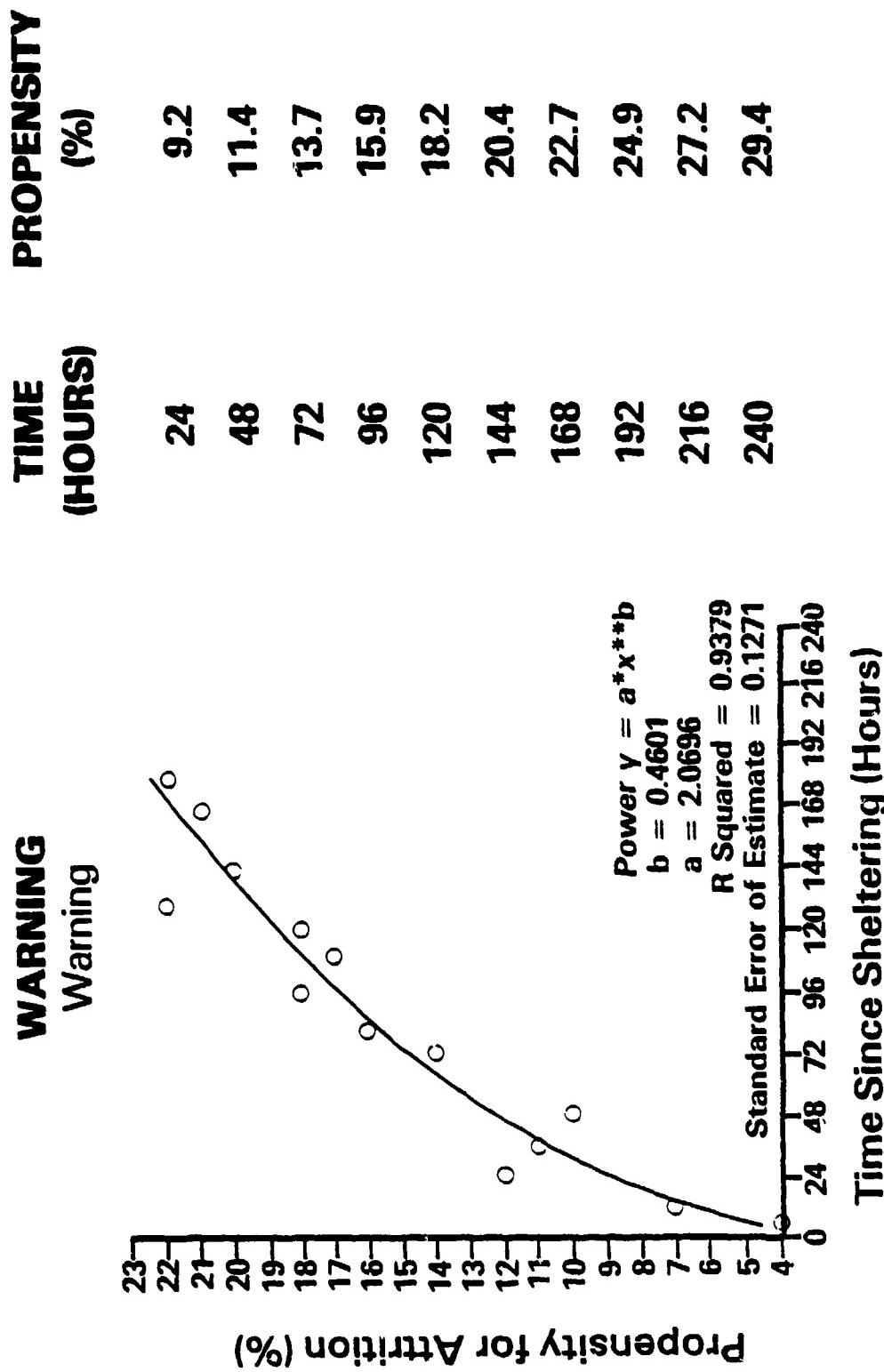
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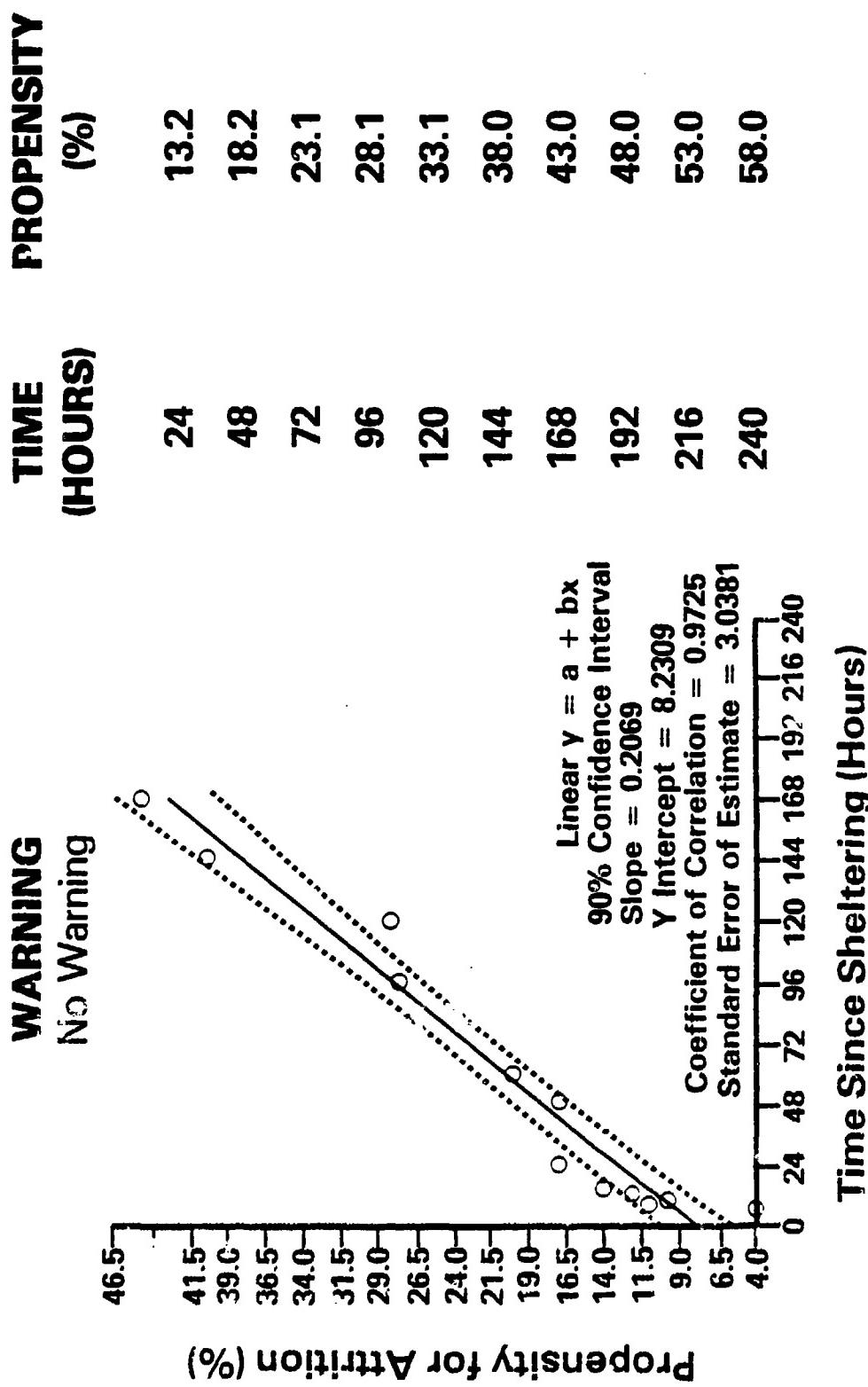
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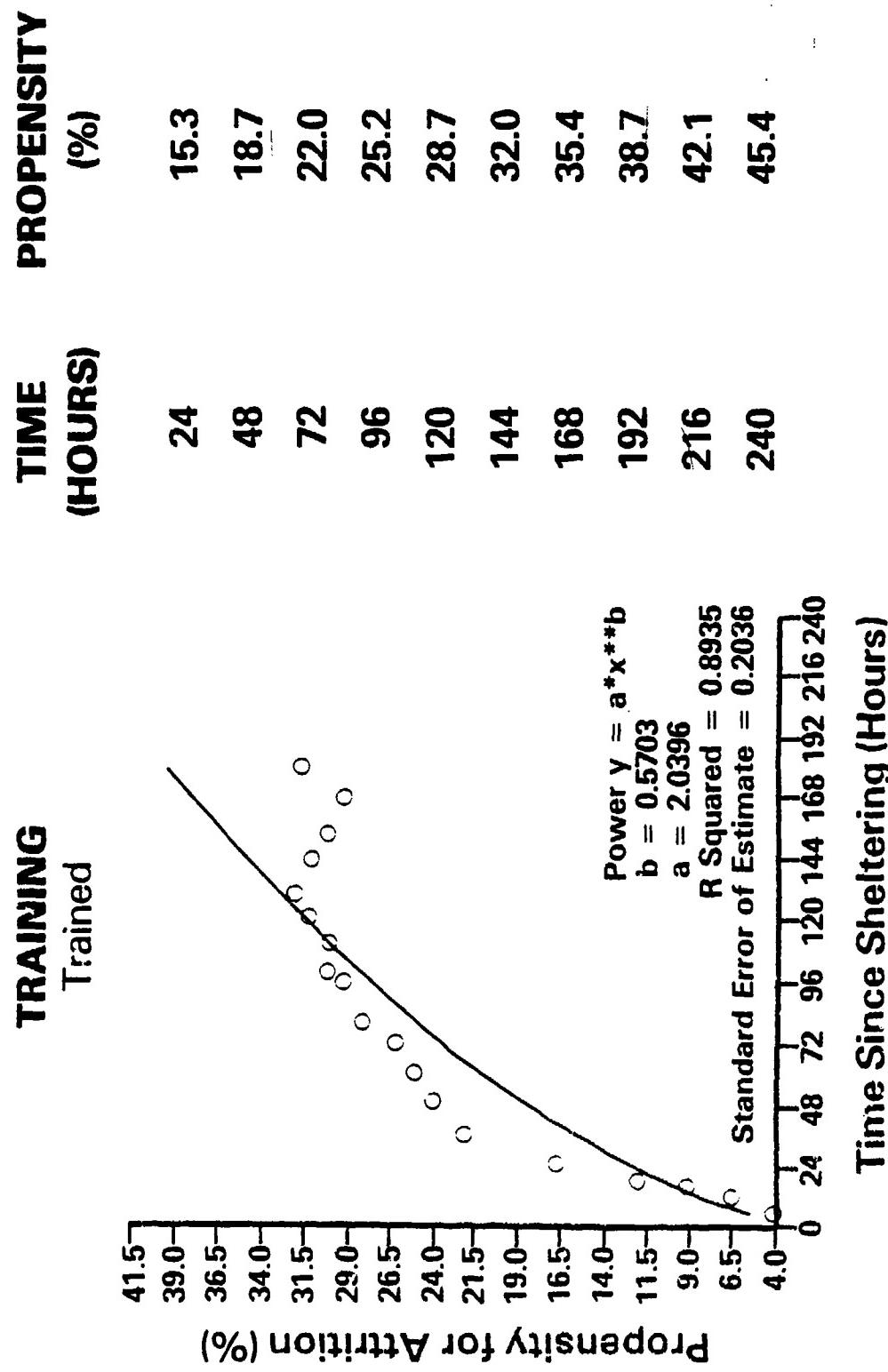
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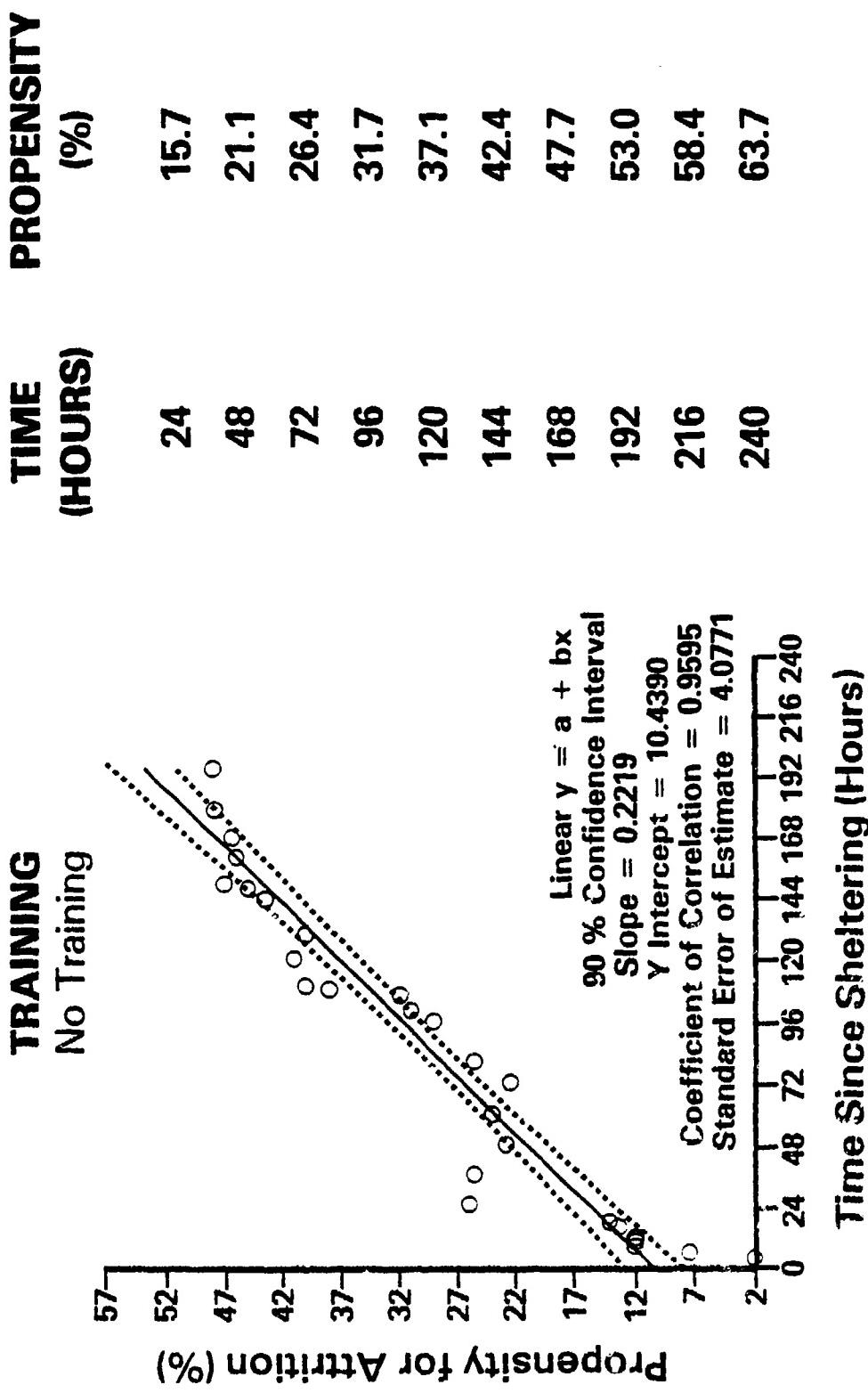
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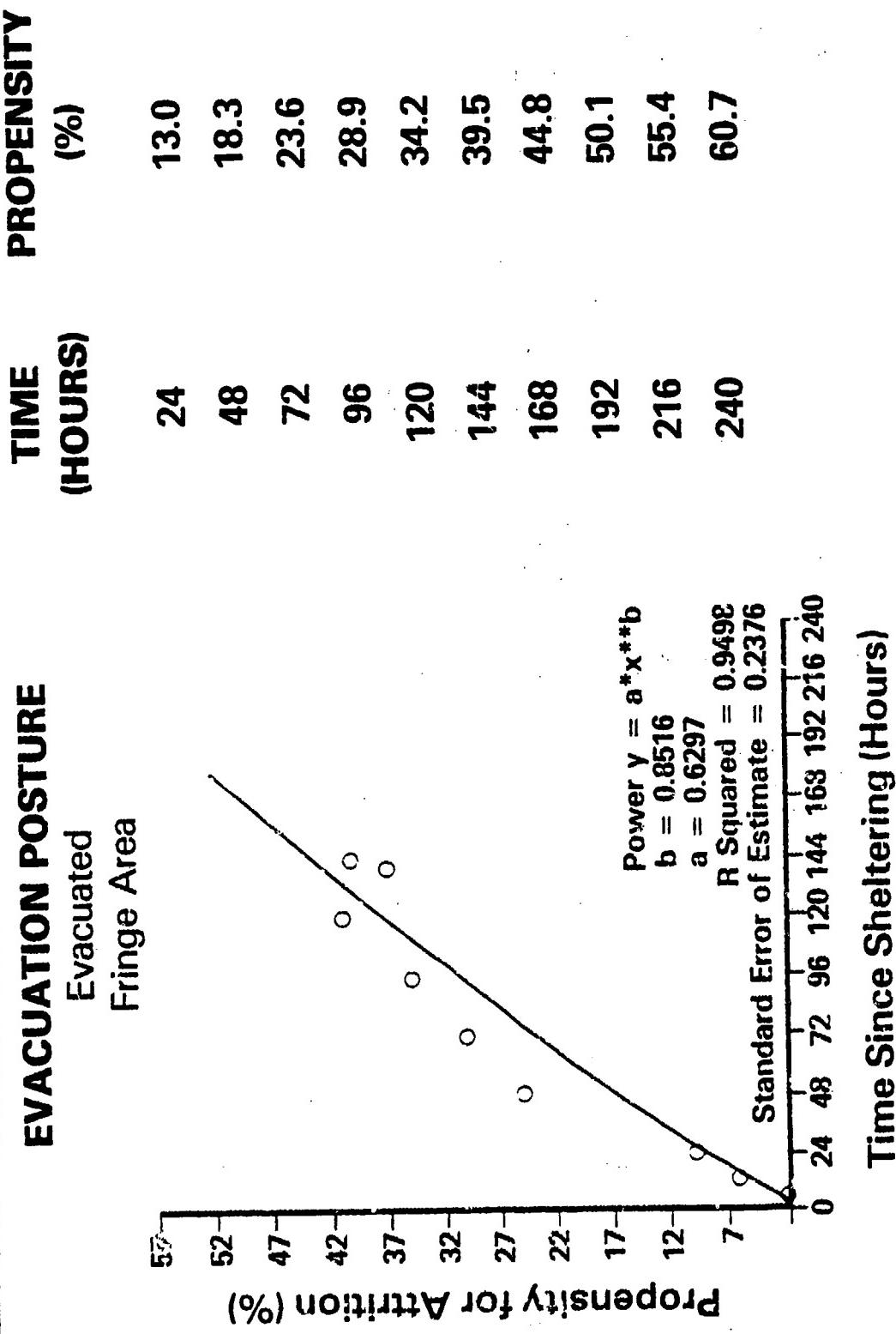
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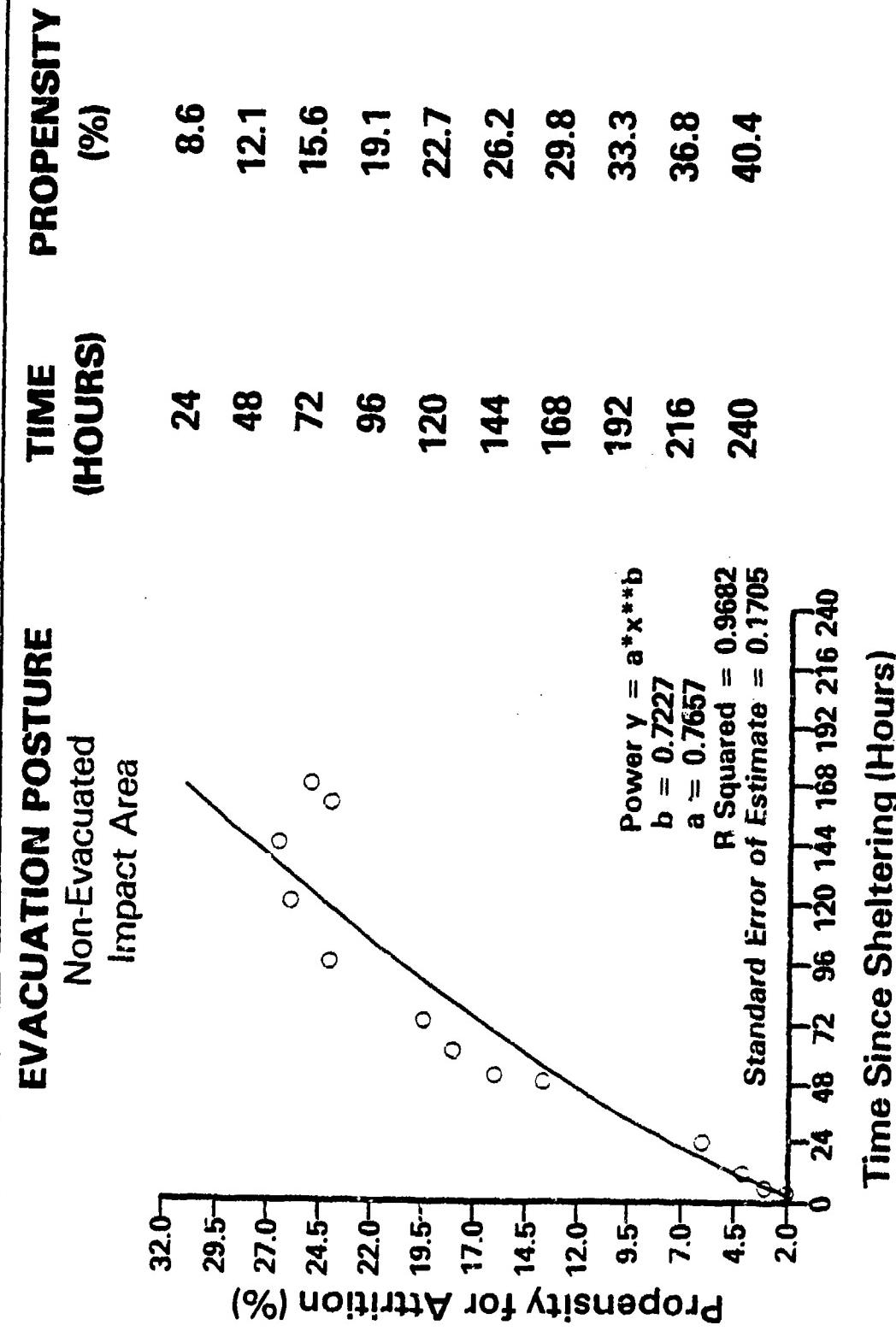
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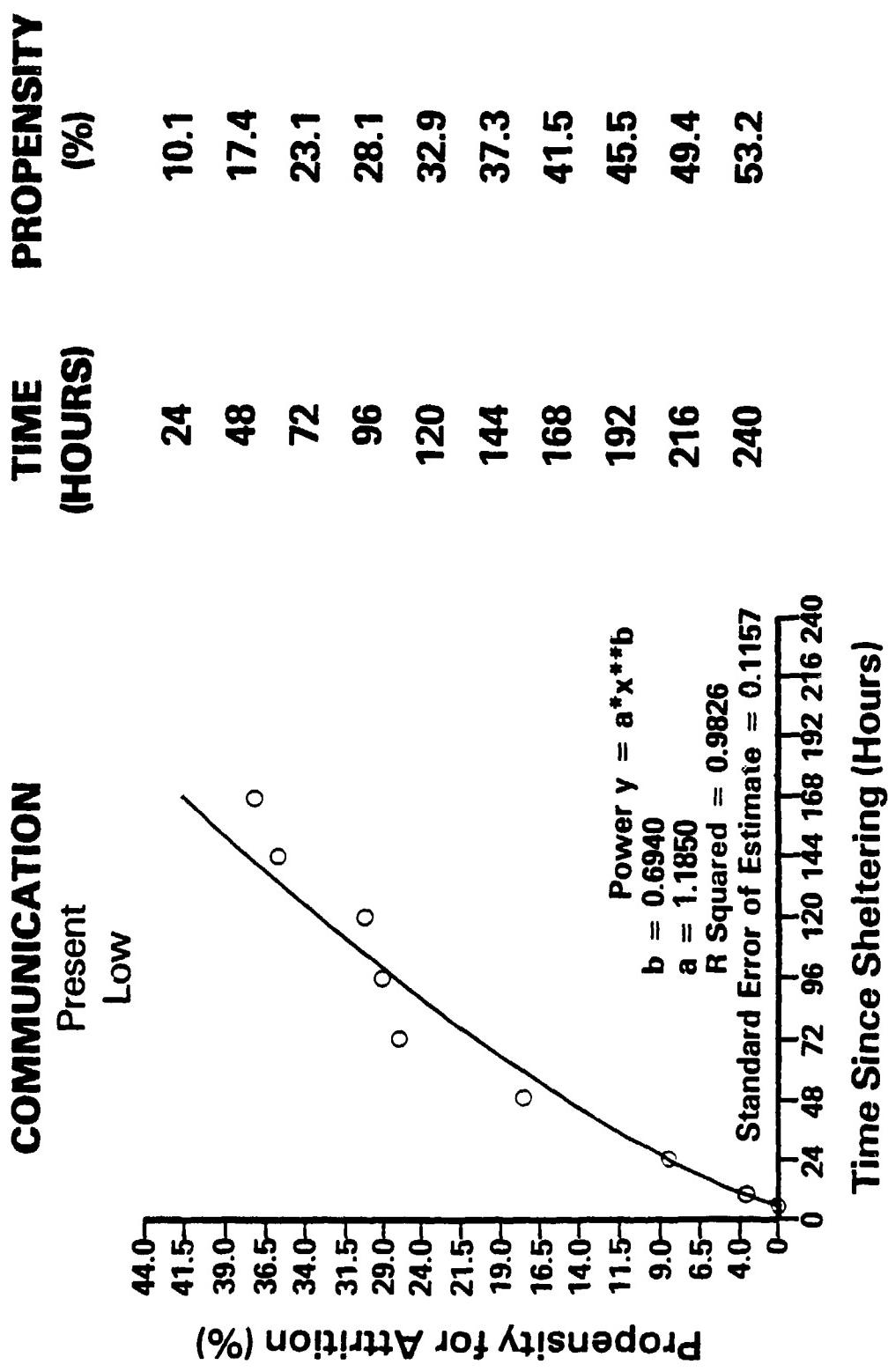
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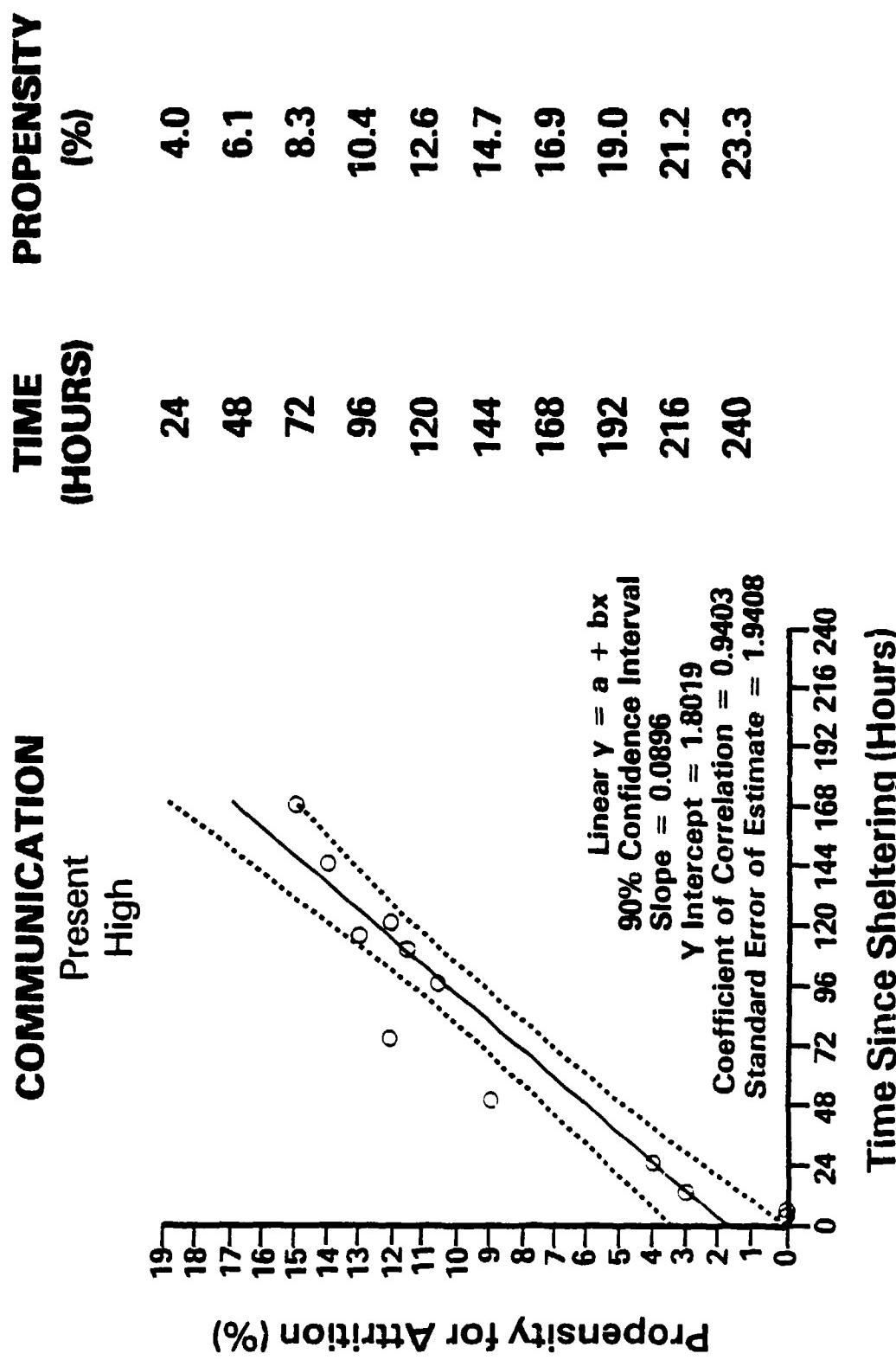
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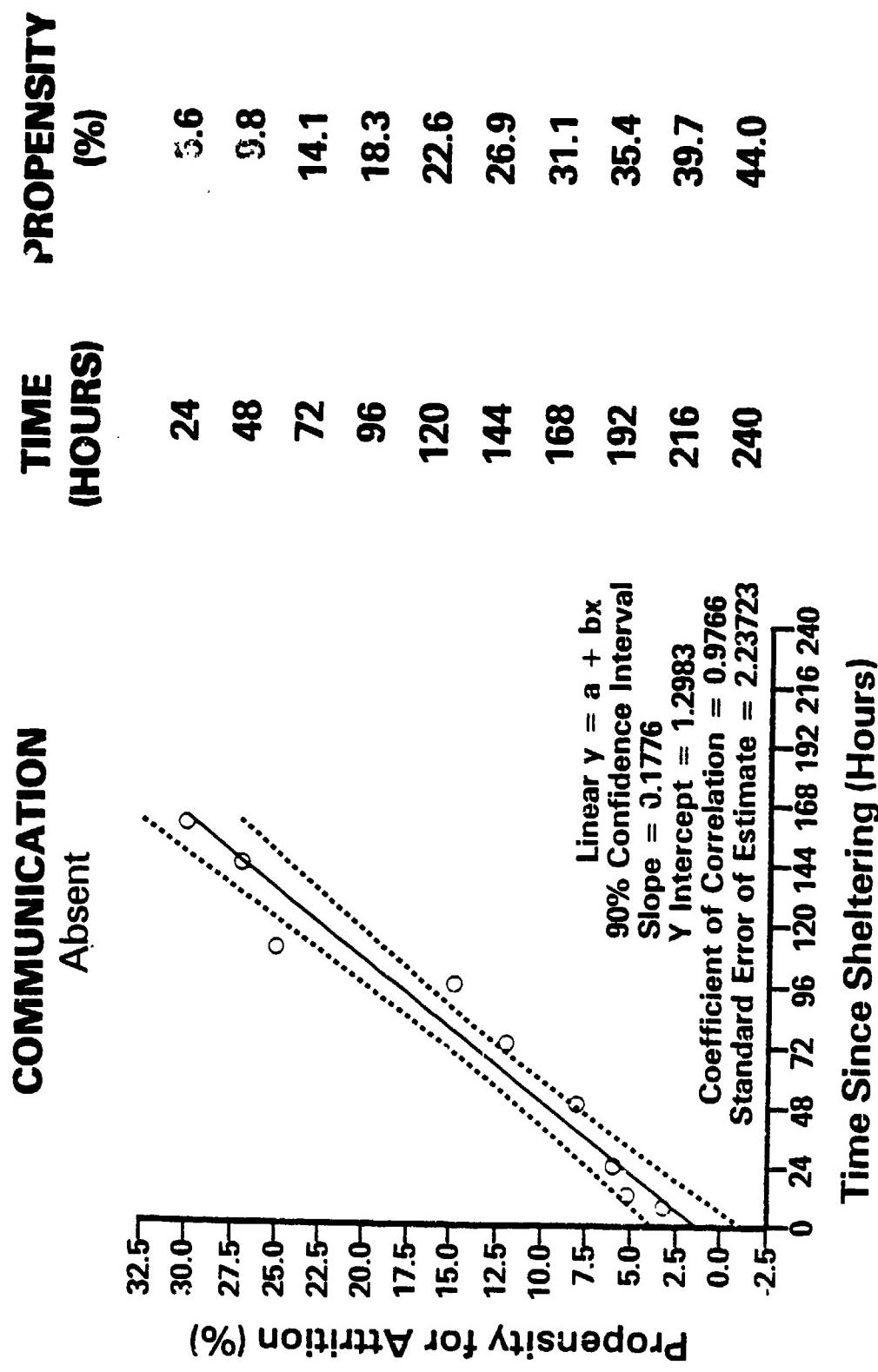
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